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Diagnosis and Evaluation of ADHD using MLP and SVM Classifiers

E. Radhamani[1] and K. Krishnaveni[2*]

[1]Madurai kamaraj University, Madurai - 625021, Tamil Nadu, India;
eradharukmani1990@gmail.com
[2]Department of Computer Science, Sri. SRNM College, Sattur-626203, Virudhunagar District, Tamil Nadu, India;
kkveni_srnmc@yahoo.co.in

Abstract

Objectives: Attention Deficit Hyperactivity Disorder (ADHD) is the neurological childhood cerebral disorder that affects five to eight percent of school-aged children's ability to control their behavior and pay attention to tasks. **Methods/ nalysis:** MLP and SVM Data mining classifiers to Diagnose and Evaluate the Attention Deficit Hyperactivity Disorder (ADHD) is proposed in this paper. It is characterized by problems with Inattention, impulsivity, and hyperactivity. School going children in the age group of 5-9 years is targeted and an ADHD data set with 105 data samples with 30 attributes is created from their parents and teachers under the guidance of physicians. The ADHD data set is preprocessed to remove duplicate records, missing data, noisy and inconsistent data and classified initially into NOADHD and ADHD. The ADHD samples are further classified into moderate ADHD (ADHDmod) and high ADHD (ADHDhigh) classes using MLP and SVM classifiers and their classification performance is evaluated with the carry of Performance Metrics, ROC curve and Accuracy measures using WEKA tool. **Findings:** The data set is experimented with WEKA tool and the performance of the classifiers is evaluated in terms of their classification accuracy using various measures like kappa statistics, Mean absolute error and Root mean squared error and ROC Area. It has been found that the accuracy of MLP algorithm is best one for ADHD data classification compared to SVM classifier. **Applications/Improvements:** Data mining techniques (MLP, SVM) are used to classify the group such as (Inattention, Hyperactivity, Impulsivity) normal and abnormal is diagnosed.

Keywords: ADHD, MLP, ROC, SVM, WEKA

1. Introduction

Data mining is the method of explore the data from different viewpoints and constriction into valuable information. It allocates the customers to evaluate data from different features[1]. Only two classification techniques are used in this paper. WEKA is a data mining tools and it provides to various classification algorithms. MLP and SVM classification algorithms are used in this paper. Classification is used to predict the data instances. Our main aim is to show the comparison between MLP and SVM classification and find out which algorithm will be most suitable in our dataset.

1.1 Weka

WEKA is a group of machine learning algorithms and trained to analyze the dataset with the data mining algorithms. The algorithms can be connected straightly to a dataset. WEKA consists of data preprocessing, classification, regression, clustering, association rules, and visualization. It is likewise appropriate for growing new machine learning plans. WEKA is produced by the University of Waikato[2]. The WEKA tool includes the four applications shown in Figure 1.

*Author for correspondence

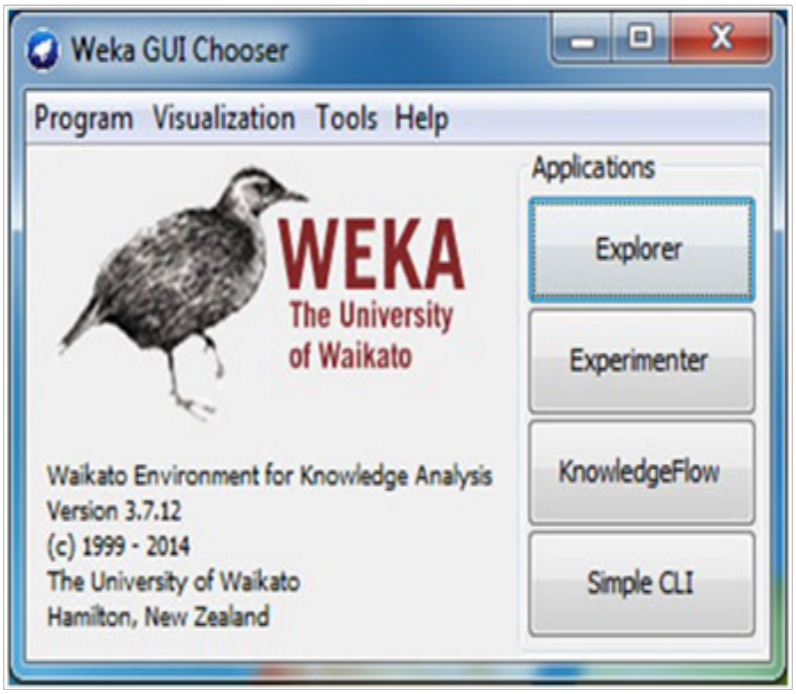

Figure 1. WEKA Interface.

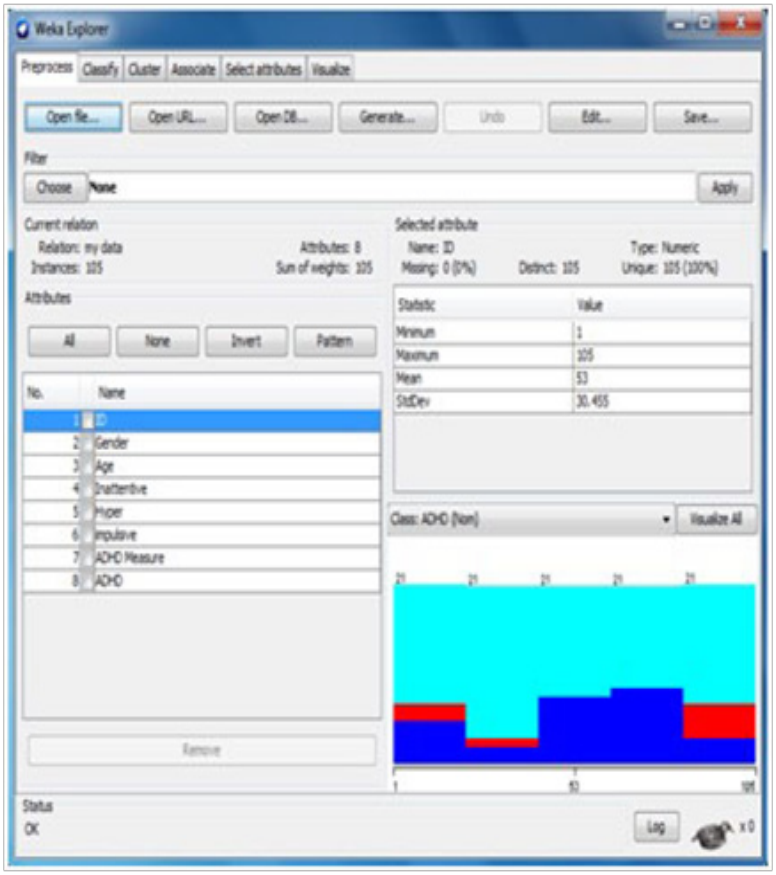

Figure 2. The WEKA Explorer user interface.

1.2 Weka Explorer

WEKA Explorer is utilized to deliver the result for the dataset. In Figure 2, includes the following categories:

- Pre-process: Preprocess to remove duplicate records, misplaced data, noisy and inconsistent data.
- Classify: It is used for the categorization purpose. A huge number of classifiers are utilized as a part of WEKA.
- Cluster: Clustering of the data.
- Associate: Generate the association rules for the data.
- Select attributes: Select attributes in the data.
- Visualize: 2D plot of the data[3].

In this paper 105 data samples are used with data mining algorithms such as MLP and SVM classifications are used. It continues to analyze and predict the class for ADHD data set. This paper is organized into four sections. Section II presents the methodology and Experimental results &analysis on ADHD data set using WEKA tool is presented in Section III. Section IV concludes the paper.

2. Methodology

2.1 Classification in WEKA

There are three steps involved in WEKA.

1. Preparing the data
2. Apply classify algorithm
3. Analysis the result

Firstly, prepare the data in .arff format after load the data and choose classification algorithm. Finally generate the output.

2.1.1 Preparing the Data

Dataset is utilized as a part of WEKA, comprises of distinctive segments in the dataset such as names, types and values of the attribute and the data. In this paper used to 105 data samples. ADHD Dataset has eight attributes: ID, Gender, Age, Inattentive, Hyperactive, Impulsive, ADHD measure, and ADHD as listed in the Table 1.

Output classes- NoADHD, ADHDmod, ADHDHighwere listed in the Table 2.

Table 1. ADHD Data Set

Attribute Name	Data Type	Description
ID	Numeric	ID Number
Gender	Numeric	Male(0) or Female(1)
Age	Numeric	5-9 years
Inattentive	Numeric	Sum of the rating scale of Group I
Hyperactive	Numeric	Sum of the rating scale of Group II
Impulsive	Numeric	Sum of the rating scale of Group III
ADHD measure	Numeric	Sum of Inattentive, Hyperactive and Impulsive
ADHD	Nominal	No ADHD, ADHDmod, ADHDHigh

Table 2. Output variable For ADHD Data Set

ADHD	Nominal Representation
ADHDMeasure<= 30	No ADHD
ADHDMeasure> 30 AND ADHDMeasure<= 50	ADHD mod
ADHDMeasure> 50	ADHD High

2.1.2 Classification Methods

In this paper 105data samples are used. These data samples are to be classified initially into two groups namely children with or without ADHD. The target of classification is too accurately for each sample in the data set. The Data mining classifiers MLP and SVM are proposed in this paper

2.1.2.1 MLP Classifier

Multilayer Perception (MLP) system models are the well-known system designs, utilized as a part of the research applications in prescription, building, numerical modeling, etc. MLP network is one or more layers between input and output layer[4]. MLP has three unique characteristics:

1. Each neuron in the network includes a nonlinear activation function.
2. Hidden neurons are not part of the input or output layer of the network.

3. The network displays a high degree of connectivity.

In Figure 3 shows a perception network with three layers. Every neuron in every layer is associated with each neuron in the layers. The input layers are introduced to training or testing vectors and handled by the hidden and output layers.

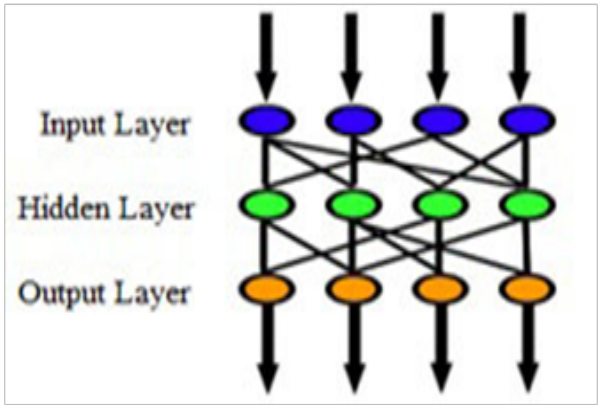

Figure 3. Multilayer Perception (MLP).

2.1.2.2 SVM Classifier

SVM (Support Vector Machine) is a supervised learning technique for Data search, Pattern acceptance and Classification based on statistical learning theory[5]. SVM classification creates an *N*-dimensional hyper plane and separates the data into two categories. Initial one is Linear SVM classifier, separates the data points used to a linear decision boundary. Liner SVM separated by a hyper plane into two divisions. Second one is Non-linear SVM classifier, separates the data points used to a non-linear decision boundary. Non-linear SVM can be utilized for such difficult datasets[6].

In Figure 4 shows, SVM Classifier, this classifier expands the separation between two classes to make a classifier. The target of an SVM is to separate the data into two classes using from the training data to separating hyper plane. The hyper planes are known as the "support vectors" and the separation between the hyper plane and the closest support vector is described as the "Margin".

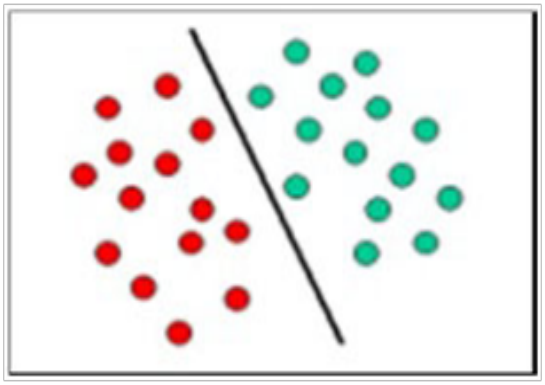

Figure 4. Support Vector Machine (SVM) Classifier.

3. Experimental Results and Analysis

3.1 Classifiers

MLP and SVM classifiers in WEKA are implemented on ADHD data set. The classifier results are shown in Figure 5& Figure 6.

3.2 Analyzing Results

The results of the classifiers are analyzed and discussed based on performance metrics. 10-fold cross-validation strategy is utilized to assess the execution of grouping strategies. In this technique, data set was divided into ten equal sized partitions, through the partitions nine of them were used as training set and the remaining one is used as a test set. It is used to evaluate the performance of classification algorithms. Performance is compared using kappa statistics, Mean absolute error and Root mean squared error and ROC curve metrics[7].

3.2.1 Kappa Statistics

The kappa statistic measures the agreement of prediction with the true class - 1.0 signifies complete agreement. If K =1 is perfect agreement or If K=0 is chance of agreement.

3.2.2 Mean absolute error (MAE)

MAE: It measures from actual values explicitly total size of the individual errors. It is a little smaller than the RMSE.

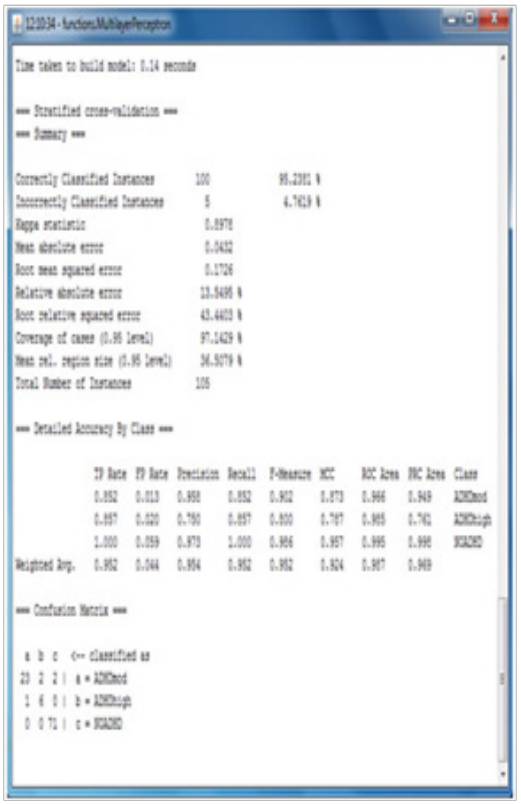

Figure 5. Output of MLP.

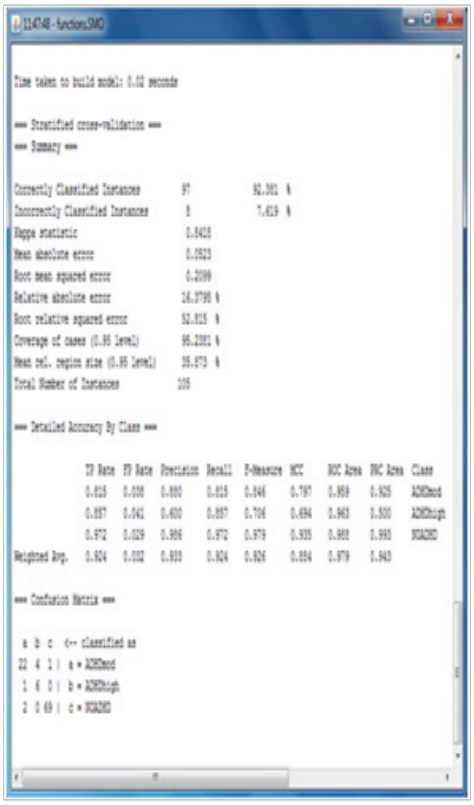

Figure 6. Output of SVM.

3.2.3 Root mean squared error (RMSE)

RMSE: It is used to measure the accuracy. It calculates the differences between values predicted by a model. The RMSE will always be larger or equal to the MAE. If the RMSE=MAE, then all the errors are of the same magnitude.

Table 3. Performance Comparison of MLP & SVM Classifiers

Parameters	Classifiers	
	MLP	SVM
Correctly Classified	100	97
Incorrectly Classified	5	8
Kappa statistic	0.8978	0.8418
Mean absolute error	0.0432	0.0523
Root mean squared error	0.1726	0.2099

The performance comparison of SVM and MLP classifiers is reported in Table 3, it has been identified that out of 105 instances the MLP algorithm classifies 100 samples Correctly Classified (Kappa statistics-0.9, MAE-0.04 and RMSE- 0.17). But in SVM, 97 samples correctly classified (Kappa statistics- 0.8, MAE-0.05 and RMSE- 0.20). Accuracy and Comparative performance metrics is given in Figures 7 and 8.

In Figure 7 shows, Accuracy chart for SVM and MLP classifiers. MLP classifier gives 95% accuracy on ADHD dataset compared to SVM classifier which gives up 92% accuracy.

In Figure 8 shows, the performance comparison of SVM and MLP classifiers.

3.2.4 ROC area

Receiver Operating Characteristic (ROC) area is another way to check the performance of the classifiers. It is a technique for visualizing, organizing and selecting classifiers based on their performance.ROC area is two-dimensional graphs in which tp rate (1) is plotted on the Y axis and fp rate (2) is plotted on the X axis. An ROC graph transaction between true positives (benefits) and false positives (costs). The ROC area values are displayed in Table 4for different classes of ADHD classes.

$$tprate = \frac{Positivescorrectlyclassified}{Totalpositives} (1)$$

$$fprate = \frac{Negativesincorrectlyclassified}{Totalnegatives} \quad (2)$$

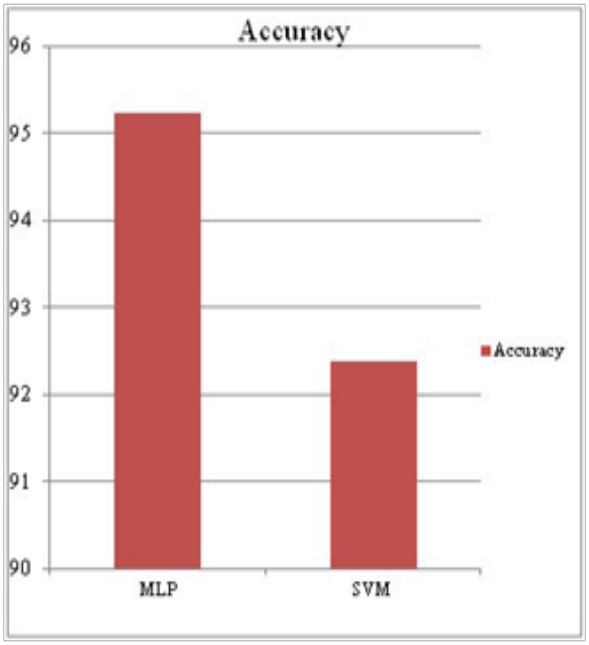

Figure 7. Accuracy Chart for Classifiers.

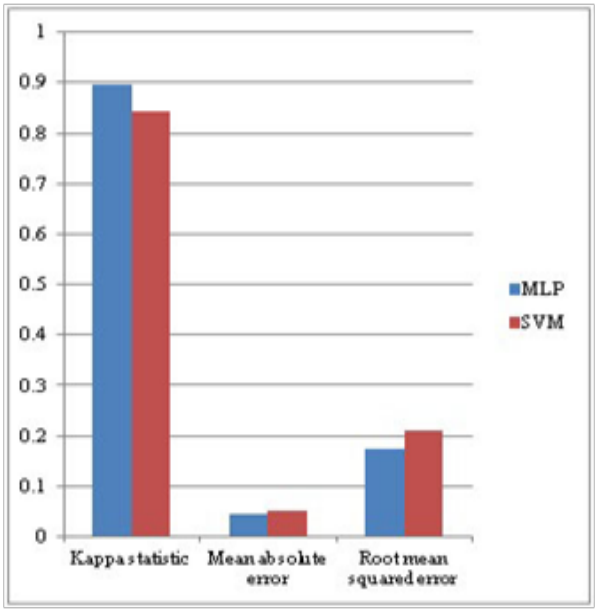

Figure 8. Performance Metrics.

Table 4. ROC Area for Various ADHD Classes

ADHD Classes	ROC Area	
	MLP	SVM
No ADHD	0.995	0.988
ADHD mod	0.966	0.959
ADHD High	0.985	0.963

Figure 9 shows an ROC area with two classifiers (MLP and SVM). The chart shows, accuracy of MLP classifier based on ROC area values is high compared to SVM classifier.

4. Conclusion

In this paper, the diagnosis of Attention Deficit Hyperactivity Disorder in the age group of 5-9 years of school going children using MLP and SVM Data Mining classifiers is proposed. An ADHD data set containing 105 real data samples are used. The data set is experimented with WEKA tool and the performance of the classifiers is evaluated in terms of their classification accuracy using various measures like kappa statistics, Mean absolute error and Root mean squared error and ROC Area. It has been found that the accuracy of MLP algorithm is best one for ADHD data classification compared to SVM classifier.

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