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A Survey on Prediction of Brain Hemorrhage Using Various Techniques

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Abstract

Objectives: The main objective of this work is to predict Subarachnoid haemorrhage (SAH) using machine learning techniques and analyzing the classification performance of various existing machine learning algorithms.
Methods: Diagnosing theSubarachnoid haemorrhage can be done efficiently by various machine learning techniques. Purpose of using Machine learning technique is to focus on factors that influence the prediction performance.
Findings: Subarachnoid haemorrhage is a stroke which is recognised by the occurrence of blood in subarachnoid space. Diagnosis of such potential disease becomes more important in the medical research area. Most widely used data mining methods for prediction tasks are decision rules, naïve Bayesian classifiers, support vector machines, Bayesian networks, and nearest neighbors. Some of the methods namely boosting, bagging and genetic algorithms have limited usage in the prediction.
Application/Improvements: The finding of this work shows that random forest classifier provides effective classification result than other machine learning techniques.

Keywords: Subarachnoid haemorrhage, machine learning techniques, Support Vector machine, naïve Bayesian classifiers, Bayesian networks, genetic algorithm

1. Introduction

Subarachnoid haemorrhage is a stroke which is recognised by the occurrence of blood in subarachnoid space. The main reason for subarachnoid haemorrhage is the burst of cerebral aneurysm and cerebral artery dilation. Diagnosis of such potential disease becomes more important in the medical research area. There are various statistical approaches used for prediction. Prognostic score estimated from logistic regression model were commonly utilized for categorizing the patients based on the risk factors. Furthermore, there are several statistical and machine learning algorithms applied for detecting of subarachnoid haemorrhage. Most widely used data mining methods for prediction tasks are decision rules, naïve Bayesian classifiers, support vector machines, Bayesian networks, and nearest neighbors [1]. But, some of the methods namely boosting, bagging and genetic algorithms have limited usage in the prediction.
Data mining can be used for different applications for example Health care Industries. The main purpose of using the machine learning techniques is to address the factors that influence the prediction performance such as accuracy of prediction, interpretability of classification models, managing the missing data, handling noise, reducing the attributes, computational cost and making the decisions. This paper discusses the machine learning approaches used for predicting the haemorrhage and compares them based on their merits and demerits.
In [2] presented the inductive machine learning techniques for diagnosing the hemorrhagic strokes resulted by subarachnoid hemorrhage. Initially, training dataset was considered along with attributes and classes. Total training set was partitioned into subsets for determining the classes to which the test data belongs to. Then the partial information with respect to each subset was created by each attributes. At last, decision tree was constructed using gain criteria which correspond to the specific attribute and finally predict the hemorrhage. The proposed method can able to manage the missing or unknown attribute in training data set.

In [3] diagnosed the brain hemorrhage by utilizing watershed method on segmented CT scan images. In this approach, initially, CT images of brain were converted into the particular format and they were sent to the pre-processing module. Then objects in the brain images were separated and the features were extracted from each object using watershed method. Extracted features were used to construct the artificial neural network. During testing phase, the type of hemorrhage was recognized based on the trained neural network.

In [4] recognized the hemorrhages in brain by segmenting the brain CT images automatically. Initially images were pre-processed. Histogram based centroids initialization and K-means clustering algorithm were then introduced on the pre-processed image for partitioning the image of different clusters with respect to their pixel intensity values. Centers of the clusters were found by using histogram analysis. Finally, hemorrhage was recognized from analyzing the clusters formed during clustering process.

In [5] focussed on diagnosing the hemorrhagic shock in rat models by utilizing Random Forest model. Initial step was to prioritize input variables by Breiman's method. 5-fold cross validation was then repeated for estimating the mean accuracy by backward elimination process. Then highest ranked variables with the best cross validated accuracy were selected as optimal variables. Selected optimal variables were used for constructing the prediction model.

In [6] developed Artificial Neural Networks for diagnosing the brain hemorrhage. The proposed diagnosing system extracted the features from CT scan images using watershed method and given them as input to the artificial neural network for classifying the types of hemorrhages. Outputs were verified by experts and learning tools were used to reduce the errors caused during verification.

In [7] introduced an automatic detection and classification method for improving the prediction performance of Brain hemorrhage. In this method, removal of skull and brain ventricles was the initial step and hemorrhages were then isolated using thresholding method. Features were then selected using genetic algorithm and the selected features were extracted from each hemorrhage region. Finally, different types of haemorrhages were identified by the Multilayer Neural Network and K-Nearest Neighbor classification.

In [8] introduced the pre-processing and pre-segmentation methods to detect the hemorrhage using brain image. Initial step was to pre-process and crop the brain image for removing the extra information. The pre-processed image was then pre-segmented into four quadrants by utilizing split and merge technique for identifying the abnormal regions of brain. Then the abnormality regions were segmented by grouping the homogeneous regions based on the predefined criteria.

In [9] presented the automatic segmentation of hemorrhagic region from brain CT images. The proposed technique used fuzzy clustering method for initializing the level set function and automatically measured the level set evolution controlling parameters. Then the area and length of the contour generated by the clustering method were computed for hemorrhagic prediction.

In [10] developed a hybrid intelligent machine learning technique to detect brain tumor automatically through magnetic resonance images. This technique adapted feedback pulse-coupled neural network for image segmentation, the discrete wavelet transform for features extraction, the principal component analysis for minimizing the wavelet coefficients dimension and the feed forward back-propagation neural network for normal or abnormal classification.

In [11] proposed an automatic brain hemorrhage detection and classification algorithm for locating and identifying types of hemorrhages. The first process of the technique was pre-processing the CT images. Hemorrhage regions were detected and isolated from the image using Distance Regularized Level Set Evolution (MDRLSE). Then shape and texture features were extracted from each detected hemorrhage region. Synthetic feature selection algorithm was applied for selecting the suitable features for classifying hemorrhages.

2. Comparison tabulation

Ref. no.	Title	Methods used	Disadvantages
[2]	Medical diagnosis of stroke using inductive machine learning.	inductive machine learning technique, decision tree	Instability for continuous data set.
[3]	Intelligent brain hemorrhage diagnosis system	watershed method, artificial neural network	Over-fitting problem and computational complexity
[4]	Automatic segmentation of brain CT scan image to identify hemorrhages	Histogram based centroids initialization and K-means clustering	Sensitive to noisy or redundancy data
[5]	A Survival Prediction Model of Rats in Hemorrhagic Shock Using the Random Forest Classifier	Breiman's method and rando forest classifier.	Slow prediction
[6]	Intelligent brain hemorrhage diagnosis using artificial neural networks	Artificial Neural Network and learning tool	Computational burden

[7]	Automatic brain hemorrhage segmentation and classification in CT scan images	Thresholding method, genetic algorithm, Multilayer Neural Network and K-Nearest Neighbor classification	Convergence rate to obtain better result is low
[8]	Pre-segmentation for the computer aided diagnosis system	pre-segmentation process	Consumes more power
[9]	Intracranial hemorrhage detection using spatial fuzzy c-mean and region-based active contour on brain CT imaging	fuzzy clustering method, region-based active contour	More number of iterations is required for achieving better detection result
[10]	Computer-aided diagnosis of human brain tumor through MRI: A survey and a new algorithm	feedback pulse-coupled neural network, discrete wavelet transform, principal component analysis and feed forward back-propagation neural network	More power consumption and software complexity
[11]	Automatic brain hemorrhage segmentation and classification algorithm based on weighted grayscale histogram feature in a hierarchical classification structure	MDRLSE and Synthetic feature selection algorithm	Does not support large dataset

3. Conclusion

There were various techniques developed for effectively detecting the hemorrhage in the brain. Random forest classifier described in this paper though takes more time to prediction, shows better classification result and improves the prediction accuracy than other techniques.

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