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Diagnosis of Various Thyroid Ailments using Data Mining Classification Techniques

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ABSTRACT

Classification is one of the most considerable supervised learning data mining technique used to classify predefined data sets the classification is mainly used in healthcare sectors for making decisions, diagnosis system and giving better treatment to the patients. In this work, the data set used is taken from one of recognized lab of Kashmir. The entire research work is to be carried out with ANACONDA3-5.2.0 an open source platform under Windows 10 environment. An experimental study is to be carried out using classification techniques such as k nearest neighbors, Support vector machine, Decision tree and Naïve bayes. The Decision Tree obtained highest accuracy of 98.89% over other classification techniques.

Keywords : Thyroid disease, K-Nearest Neighbor, Support Vector Machine, Decision Tree, Naïve Bayes.

I. INTRODUCTION

Classification techniques play a vital as well as major role in analyzing survivability of diseases and providing facilities to reduce the cost to the patients. Now-a-days, Disease diagnosis has become very crucial because of occurrence of so many diseases every year. People from all over the world have been suffering from various health issues like diabetes, heart disease, typhoid, tuberculosis, kidney disease etc [16] [17].Beside these health issues , thyroid disease have also been detected worldwide and thus become a serious endocrine health problem and an issue of concern. It is expected that in India about 42 million people suffer from thyroid disorders [2]. As per resent studies, women are 5 to 8 times more prone to thyroid disorders than men worldwide. It is caused by the improper secretion of thyroid hormones released from the thyroid gland which is one of the important organlocated in the front of the neck and below the Adam's apple of our body. The secretion of thyroid hormones from the thyroid gland are of two types i.e. levothyroxine or T4 and triiodothyronine or T3. These hormones help in production of balanced amount of proteins, regulating the temperature of body, and maintaining overall production of energy [18]. Thyroid disease occurs when thyroid gland stop to functioning properly and are mainly divided into hypothyroidism and hyperthyroidism [4].

The excess and deficient secretion amount of thyroid hormone causes hyperthyroidism and hypothyroidism respectively. The common symptoms of hyperthyroidism are sudden weight loss, rapid heartbeat, nervousness, etc. and

hypothyroidism has weight gain, tiredness, weakness, feeling cold etc. One of the most common cause occurred due to hyperthyroidism is graves' disease [3]. The underestimated thyroid disease causes thyroid storm and myxedema which may lead to death [12].

In this research work, a classification model is trained using classification algorithms like K-nearest neighbor (KNN),support vector machine (SVM), decision tree (DT) and Naïve bayes (NB) for the diagnosis of thyroid diseases. The Decision Tree outperformed over other techniques.

The rest of the paper is followed as: - Section 2 represents related work in diagnosis of thyroid diseases. Section 3 contains dataset and methods. Section 4 represents the results and discussion. Section 5 contains conclusion and at last references are mentioned.

II. RELATED WORK

By studying literature, it seems that several classification methods have been developed for thyroid diseases diagnosis. In year 2002, Ozyilmaz et al in [14] showed that feed forward neural network could be successfully used for diagnosis of thyroid diseases. In this work, three architectures of MLP, RBF and CSFNN were used and achieved accuracy 89.80%, 79.08% and 91.14% respectively. This work shows CSFNN gives the best classification accuracy and takes less training times than all other algorithms.

In 2007, Polat et al. studied on the artificial immune-recognition system (AIRS) classification method for diagnosis of thyroid diseases and achieved 81% classification accuracy. On the other hand AIRS with Fuzzy weighted pre-processing was classified and showed the accuracy of 85.00% .This means AIRS with fuzzy outperformed than AIRS [15].

In year 2008, keles et al. proposed an expert system for thyroid disease diagnosis (ESTDD) and using neuro fuzzy method emplaced in ESTDD system for thyroid diseases diagnosis and achieved 95.33% of accuracy. ESTDD is one of significant tool for endocrinologists or students studying endocrinology for testing their knowledge by comparing their predictions with ESTDD[21].

In year 2009, Temurtas performed diagnosis of thyroid diseases with the help of artificial neural network with 3-fold and 10-fold cross-validation approaches were used to estimate the performance of the used neural networks. In this work highest accuracy of 94.81% was achieved [12].

In year 2011, EsinDogantekin et al. worked on Wavelet Support Vector Machine (WSVM) with Generalized Discriminant Analysis (GDA) methods for diagnosis of thyroid diseases and achieved 91.86% classification accuracy [22].

K.Saravana Kumar et al in 2014, proposed KNN and SVM classification methods for the diagnosis of thyroid disease. They showed that the prediction accuracy of KNN and SVM are 96.34% and 94.43% respectively [1].

In year 2017 MP Gopinath proposed SVM, FKNN and Decision tree for the diagnosis of thyroid diseases. The SVM obtained highest classification accuracy of 96.30% over other techniques [23].

III. DATASET AND METHODS

The dataset used in this investigate work is a clinical dataset. The dataset was taken from one of the leading diagnostic lab in Kashmir. The dataset contains the record of 807 patients of almost all age groups. Out of 807 patients (224 Males and 583 Females) 553 belongs to normal, 218 belongs to hypothyroidism and 36 belongs to hyperthyroidism. The dataset has 6 attributes as: age, gender, TSH, T3, T4 and added classification attribute for indication of

normal or hyperthyroidism or hypothyroidism. Table 1 shows the description of dataset.

Table 1. Attributes used in our dataset.

Serial No.	Attribute name	description	Value
1	Age	Age in years	Numeric
2	Gender	M-Male F- Female	Nominal
3	TSH	Continuous	Numeric
4	T3	Continuous	Numeric
5	T4	Continuous	Numeric
6	Results	Normal Hyperthyroidism Hypothyroidism	Nominal

K Nearest Neighbour

K-nearest neighbour (KNN) is a supervised technique as well as non-parametric in nature. The input of K-NN depends on the K closest instances present in the feature space. The generated output depends on whether KNN is Classification or regression methods [7] [8].When prediction is required for undetected data instances, the KNN algorithm will search through the training data instances for the k-most similar instances. The prediction attribute of the most similar instances is summarized and returned as the prediction for the undetected instance [19].

Support Vector Machine

Support vector machine (SVM) is a supervised learning classification technique that are used to analyzethe data for regression and classification methods [9].It constructs an optimal hyper plane in a high- or infinite-dimensional space in which new examples are assigned to one group or the other one[10].The separation of data is achieved by the hyper plane is generally done, that has largest distance to the closest training data point of any class (so-called functional margin), since in general the greater the margin the smaller the generalization error of the classifier [19].

Decision tree

Decision Tree (DT) is tree like graph known as one of the most admired classification data mining technique that splits the dataset into parts on the decisions [5]. In decision tree, each internal node or non-leaf node represents a test on a particular attribute, each branch denotes the outcome of that test, and each leaf node has a class label. The paths through which a particular test data is to classify from root to leaf represent classification rules based on maximum information gain [6].

Naïve Bayes

Naïve Bayes (NB) is a simple classification algorithm for predictive modeling with clear semantics, representing and the probabilistic learning method based on Bayesian theorem [13]. Naive Bayes classifier assumes that the value of one attribute is not dependent on the value of any other attribute, and it assumes that the presence or absence of particular attribute doesn't affect the prediction process. Suppose there are m classes say C1, C2….Cn having a unidentified data sample X, Naive Bayesian classifier will predict an unknown sample X to the class Ci on the basis of class having highest probability [20].

$P(Ci|X > P(Cj|X)$ for $1 \le j \le m$, $j \neq i$

Anaconda

For implementation of our methods we used ANACONDA3-5.2.0 64 bit a free and open source platform distribution of python and R programming language with number of modules, packages and libraries that provides multiple ways of achieving classification problems. ANACONDA can be downloaded from the website [11].

K- Fold cross- validation

In k-fold validation, the whole dataset is divided into K equal size subsets and one of the subset K is taken as test data and the remaining K-1 folds acts as training data. Thus different test results exist on each iteration and at last average of these results gives the test accuracy of the algorithm [12]. In this study 10-fold cross-validation is used to find out the classification accuracy by the classification methods.

System implementation

The thyroid dataset has three output categories. First one is Normal, second one is hypothyroidism and third one is hyperthyroidism. The thyroid dataset of five input attributes Age, Gender, TSH, T3 and T4 is supplied to the classifiers of KNN, SVM, Decision Tree and Naïve bayes in PYTHON to classify the data. The performance of each classifier is evaluated in terms of accuracy as shown in figure 1.

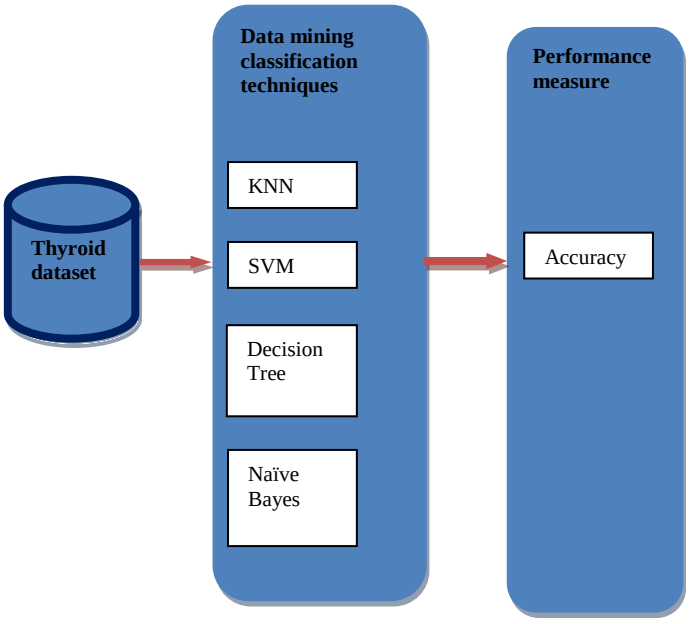

Figure 1. Thyroid disease prediction process

IV. RESULTS AND DISCUSSION

In this work, Out of four classifiers, The Decision Tree shows highest test accuracy of 98.89% over other classifiers. The accuracy comparison among classifiers is shown in figure 2. The highest accuracy of our method is higher than some of the methods available in literature as shown in table 2.

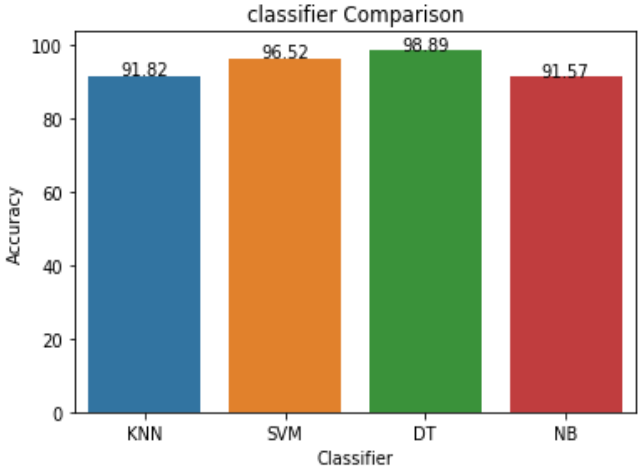

Figure 2. Accuracy comparison of classifiers

Study	Method	Highest Accuracy
Ozyılmaz and Yıldırım [14]	MLPNN with BP (3×FC)	91.14%
	MLPNN with FBP (3×FC)	
	RBF (3×FC)	
	CSFNN (3×FC)	
Polat et al. [15]	AIRS (10×FC)	85.00%
	AIRS with Fuzzy (10×FC) weighted preprocessing	
keles et al. [21]	ESTDD	95.33%
F. Temurtas [12]	MLNN with LM (3×FC)	94.81%
	PNN (3×FC)	
	LVQ (3×FC)	

	MLNN with LM (10×FC)	
	PNN (10×FC)	
	LVQ (10×FC)	
EsinDogantekinet al.[22]	GDA-WSVM	91.86%
MP Gopinath.[23]	SVM	96.30%
	FKNN	
	Decision Tree	
Our study	KNN (10×FC)	98.89%
	SVM (10×FC)	
	DT (10×FC)	
	NB (10×FC)	

Table-2 shows the highest classification accuracy obtained by our method over other methods used for the diagnosis of thyroid diseases.

V. CONCLUSION

The work has been done using classification data mining techniques for the diagnosis of thyroid disease. For this purpose, K nearest neighbor, Support vector machine, Decision tree and Naive Bayes classifiers have been used. The Decision Tree classifier outperformed over other classifiers. However, if we merge it with any other classification technique such as neural network, then the result might be even better as compared to what we got with the current study.

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