International Journal of Innovative Technology and Exploring Engineering (IJITEE)
ISSN: 2278-3075 (Online), Volume-4 Issue-3, August 2014

Automatic Recognition of Parkinson's disease via Artificial Neural Network and Support Vector Machine

Aprajita Sharma, Ram Nivas Giri

Abstract*— Parkinson's Disease (PD) is the next mainly common neurodegenerative disease only exceeds by Alzheimer's Disease (AD). Parkinson's disease is a general disease of central nervous system along with the aged person and its difficult symptoms introduce some complexities for the clinical diagnosis. Moreover, it is estimated to enlarge in the subsequently decade with accelerated treatment costs as an outcome. Medical results produces undesirable biases, faults and extreme clinical costs which influence the value of services offered to patients. Precise detection is extremely important for cure planning which can decreases the incurable results. Precise outcome can be achieved through Artificial Neural Network. In addition to being accurate, these methods must meet speedily in order to relate them for real time applications. Artificial Neural Network (ANN)-based diagnosis of medical diseases has been taken into great consideration in recent years.. In this paper three types of classifiers based on MLP, KNN, and SVM are used to support the experts in the diagnosis of PD. The dataset of this research is composed of a range of biomedical voice signals from 31 people, 23 with Parkinson's disease and 8 healthy people. For this purpose, Parkinson's disease data set, taken from UCI machine learning database was used .The results show a high accuracy of around 85.294%.

Index Terms: Artificial Neural Network, Parkinson's disease, Pattern Recognition, Support Vector Machine.

I. INTRODUCTION

Parkinson's disease is one of a bigger group of neurological situation known as motor system disorders. Historians have established confirmation of the disease as far back as 5000 B.C. It was first describe as "the shaking palsy" in 1817 by British doctor James Parkinson. Since Parkinson's early on effort in identifying symptoms, the disease comes to accept his name.Parkinson's disease is the next most general neurodegenerative illness only exceed by Alzheimer's disease [1]. It is estimated to rise in the subsequently decade with greater than ever handling costs. PD is a progressive disorder of the nervous system that influences movement. It develops slowly, often beginning with a hardly visible tremor in just one hand. But whilst tremor might be the mainly well-known indication of Parkinson's disease, the disorder as well usually cause a freezing or slowing of movement. In the typical brain, a few nerve cells construct the chemical dopamine, which convey signals inside the brain to create even movement of muscles. In Parkinson's patients, 80 percent or further of these dopamine-producing cells are degenerated, dead, or otherwise damaged. This origin the nerve cells to fire uncontrollably, leaving patients incapable to manage their movements. Although complete Parkinson's can be disabling or crippling, experts state near the beginning symptoms of the disease might be so slight and slow that patients at times pay no attention to them or aspect them to the belongings of aging. At first, patients might experience excessively tired, "down in the dump," or a small unstable. Their verbal communication could become soft and they might become ill-tempered for no reason [2]. Parkinson's disease influences a huge part of universal population. About 1% of the residents more than 55 years of age is exaggerated by this disease [3] Parkinson's disease (PD) is a demolish neuro pathological condition; characterize by progressive neuro erosion of dopamine (DA) neurons in the substantia nigra pars compacta [4]. Two studies illustrate concentration to the difficulties in the identification of the disease in the near the beginning stages [5]. In recent times, there is no medical management of PD, even though drug is available contribution significant improvement of symptoms, particularly at the near the beginning stages of the disease [6]. On the other hand, a appropriate identification at an early stage be able to result in important life saving. A system for automatic medical diagnosis would improve the correctness of the identification and decrease the cost effect. A lot of populace with Parkinson's disease will consequently be significantly dependent on clinical involvement. The necessary physical appointment to the treatment center for supervising and treatment are complicated for a lot of people with Parkinson's disease [7]. Diagnoses depend on the existence of two or additional cardinal motor features for example rigidity, bradykinesia, or rest tremor [1]. Containing a lot of features to analyze to make a diagnosis PD, expert usually makes conclusions by estimating the recent test outcome of their patients. Furthermore, the earlier conclusions made on further patients with a like condition are also done by them. These are difficult measures, particularly when the number of features that the expert has to calculate is high (high variety and quantity of these data). For these cause, PD diagnosis involve knowledge and extremely expert specialist [8]. Functional neuro imaging holds the guarantee of improved diagnosis and permit estimation in near the beginning disease. Artificial neural networks are motivated by efforts to replicate biological neural systems. The individual brain consists mainly of nerve cells known as neurons, connected together with further neurons by means

Manuscript published on 30 August 2014.
***Correspondence Author(s)
Aprajita Sharma, Department of Computer Science Engineering, Raipur Institute of Technology, Raipur, India.
Ram Nivas Giri , Department Of Computer Science Engineering, Raipur Institute of Technology, Raipur, India.

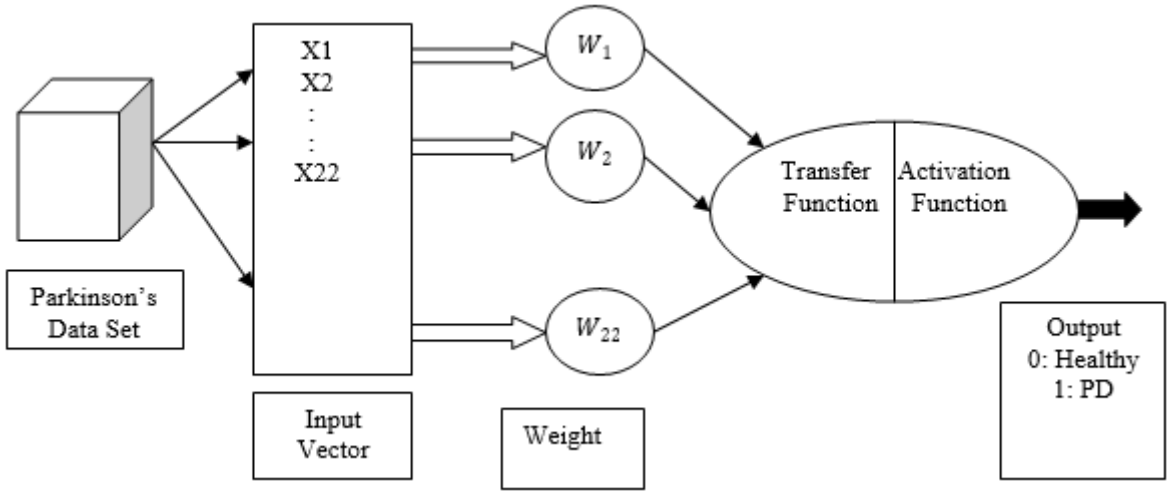

Fig.1: Topology of Neural Network

of stand of fibre known as axons. Axons are used to spread nerve impulses starting from one neuron to another whenever the neurons are stimulated. A neuron is linked to the axons of further neurons by means of dendrites, which are extension from the cell body of the neurons. The connection between an axon and dendrite is known as a synapse. A neural network offers a very common technique of future problems. At what time the outcome of the network is continuous, for example the appraise value of a home, at that time it is performing prediction. While the output has discrete values, at that time it is doing classification. A simple reorganization of the neurons and the network become practiced at identifying clusters. The reality that neural networks are so multipurpose absolutely accounts for their popularity. The attempt required to learn how to utilize them and to learn how to manipulate data is not wasted, because the information can be applied anywhere neural networks likely appropriate [8]. At the present time, with the growth of computer technology, data mining has been extensively used in a variety of fields. Clinical decision support systems (CDSSs) form a important part of the field of clinical knowledge management technologies through their ability to maintain the clinical process and use of information, from diagnosis and investigation all the way through treatment and enduring care [2]. The use of classifier systems in medical diagnosis is rising progressively. Current advances in the field of artificial intelligence include lead to the coming out of Decision Support Systems (DSS) and expert systems for medical applications. Furthermore, in the last a small number of decade's computational tools have been designed. to advance the abilities and experiences of doctors and medical specialists in making decision about their patients. With no disbelief the estimation of data taken from patients and decision of expert are still the mainly significant factors in diagnosis. on the other hand, expert systems and different Artificial Intelligence (AI) techniques for classification have the promising of being good helpful tools for the expert [9]. Classification systems can assist in increasing accurateness and reliability of diagnoses and minimizing likely errors, in addition to making the diagnoses further time efficient [8].

II. ARTIFICIAL NEURAL NETWORK

An ANN is a computational organization, motivated by the learning of biological neural processing. There are several diverse kinds of ANNs, from comparatively simple to extremely difficult; while there are a lot of theories on how biological neural processing works [10]. In further words, an ANN symbolizes a highly parallelized dynamic system with a directed graph topology that can accept the output information by way of a response of its state on the input actions. Processor element and directed channels are known as nodes of the ANN [11]. ANNs are computational tools for pattern classification that have been the topic of changed research significance for the duration of the past 15 years [12, 13]. The works in relation to threshold logic come into view in the 1960s and 1970s [14]. An ANN, a processing system example, is motivated by biological neural systems for instance brain. The key member of this novel organization is information processing system or various numbers of them, running interactively like as brain hormones with the purpose to solve a number of special problems like data classifications or pattern reorganization during this training process.

Current progress in the area of ANNs has prepared them attractive for analyzing signals. The function of ANNs has opened a novel area for solve problems which are not resolvable by further signal processing techniques [12, 13]. The ANN node presents a multiplicity of feed forward networks that are generally called back-propagation networks. Back-propagation refers to the method for calculating the error gradient for a feed forward network; a simple application of the chain rule of elementary calculus [15]. A straightforward and common topology of the ANN can be seen in Fig. 1. Each input neuron receives a numerical input from each of the variables in the dataset. All variables are stabilized to a 0-1 scale. These values are then multiply by factors, well-known as connection weights. The products of these multiplications are summed up and become the net inputs. Then these values enter into an activation function that calculates the outputs of the hidden neurons [16].

Published By:
Blue Eyes Intelligence Engineering
and Sciences Publication (BEIESP)

III. MATERIALS AND MEHODS

ANNs have broad and general uses in recognition and classification difficulties of health systems. In this section, we explain the materials and methods which are used in current research.

A. *Parkinson's Dataset*

The Parkinson record used in this paper is taken from the University of California at Irvine (UCI) machine learning repository [17]. The dataset was produced by Max little from the University of Oxford with association of the National Centre for Voice and Speech, Denver, Colorado, who record the speech signals of patients. This dataset is consisting of a range of biomedical voice measurements from 31 people, 23 of which were with Parkinson's disease and remaining are healthy. Each column in the table is a particular voice measure, and each row correspond to one of 195 voice records from these individuals ("name" column). The central plan of the facts is to categorize healthy people from individuals with Parkinson's disease, according to "status" column which is set to 1 for the people with Parkinson's disease and 0 for healthy people.

This paper reviewed the literature and used the following 23 variables as explanatory variables in Table.1. Before building models of ANNs, the data set were randomly split into two subsets the data for training set and data for testing set.

Table 1: Parkinson's Dataset

Attribute	Description
MDVP : Fo (Hz)	Average vocal fundamental frequency
MDVP : Fhi (Hz)	Maximum vocal fundamental frequency
MDVP :Flo(Hz)	Minimum vocal fundamental frequency
MDVP: Jitter (%) MDVP:Jitter(Abs) MDVP: RAP MDVP: PPQ	Several measures of variation in fundamental frequency measure of variation in fundamental frequency
RPDE D2	Two nonlinear dynamical complexity measures
DFA	Signal fractal scaling exponent
spread1 spread2 PPE	Three nonlinear measures of fundamental frequency variation
NHR HNR	Two measures of ratio of noise to tonal components in the voice
Status	Healthy, Sick

B. *Multi Layer Perceptron*

In this study we have use a Multi-Layer Perceptron (MLP) network with two layers. A two-layer MLP network is an entirely linked feedforward neural network consisting of an input layer ;which is not calculated because its neurons are only for demonstration and therefore do no processing; a hidden layer, and an output layer (ill or healthy) which correspond to the categorization result [18], [19], and[20]. Each neuron in the input and hidden layers is linked to all neurons in the subsequently layer through weighted connections. These neurons (fig1) calculate weighted sums of their inputs and add a threshold. The resultants sums are used to calculate the action of the neurons by apply a sigmoid activation function.

This process is defined as follows:

$$v_j = \sum_{i=1}^{p} w_{ji} + \theta_j \ , \ y_j = f_j(v_j) \qquad (1)$$

Where v_j is the linear combination of inputs *x1; x2; :::; xp;* and the threshold θ_j , w_{ij} is the connection weight among the neuron j and the input *xi*, and f_j is the activation function of the j_{th} neuron, and y_j is the output. The sigmoid function is a frequent selection of the activation function. It is defined as

$$f(t) = \frac{1}{1 + e^{-t}} \qquad (2)$$

A particular neuron in the MLP is able to linearly divide its input space into two subspaces by a hyper plane define by the weights and the threshold. The weights describe the direction of this hyper plane whereas the threshold term μj offsets it from origin.

The MLP network utilizes the backpropagation algorithm [Rumelhart et al., 1986], which is a gradient descent method, for the adjustment of the weights. This algorithm works as follows.

The backpropagation MLP is a supervised ANN. This means the network is presented with input example in addition to the resulting desired output. The backpropagation algorithm alter the weights and the thresholds of the neurons in a approach that reduces the error function E

$$E = \frac{1}{2}\sum_{i=1}^{m}(d_i - y_i)^2 \qquad (3)$$

Wherey_i are the actual output and $d_i$the desired output for input pattern p.

The minimization of *E* can be achieved by gradient descent; that is. the weights are adapted to alter the value of *E* in the way of it's the negative gradient. The precise updating convention can be designed by apply derivatives and the chain rule (for the weights between the input and the hidden layer)

C. *Support Vector Machine*

Support vector machines (SVMs) are binary classifiers that can be apply to linearly separate datasets. They divide data into classes by means of a hyperplane. SVMs can as well be used non-linearly by mapping the data to a higherdimensional space, therefore building the data separable. This mapping is performed by a kernel function. SVMs perform better with large feature spaces, only if the data is divisible with a wide margin [22].The most delegate instance of local neural network is the SVM, of the Gaussian kernel function.

Published By:
Blue Eyes Intelligence Engineering
and Sciences Publication (BEIESP)

It is a two layer neural network utilizing hidden layer of radial units and one output neuron. The system of constructing this network and learning its parameters is planned in the technique in which we deal only with kernel functions in its place of direct processing of hidden unit signals. SVM is a linear mechanism working in the highly dimensional feature space produced by the nonlinear mapping of the N-dimensional input vector **x** into a *K*-dimensional feature space (K>N) throughout the use of a mapping $\varphi(\mathbf{x})$. SVM is chosen here for the reason that it can straightforwardly compute the level to which people with Parkinson can be distinguish from healthy controls on the origin of measures of dysphonia, deal with the problem of categorizing subjects as PD or healthy. With such classification system, it is also potential to merge measures to construct more effective discrimination in practice [21].

SVM is being in use in a number of application areas similar to bioinformatics, image classification, character recognition, financial time series prediction, face detection, etc. SVM presents some benefits over other classification strategies similar to neural networks. Support vector machines have numerous benefits as compared with different classifiers:

• They're computationally incredibly capable as compare with diverse classifiers, mainly neural networks.
• They work fine, however with high dimensional data and with less series of training data.
• They try to reduce test error in its place of training error.
• They're very strong alongside noisy data.
• The annoyance of over fitting and dimensionality problems will not happen during classification.

D. K Nearest Neighbor

In pattern recognition, the k-Nearest Neighbors algorithm (KNN) is a non-parametric technique useful for regression and classification.[1] In each case, the input consists of the k closest training examples in the feature space. The result is based on whether KNN is used for regression or classification. When performing k-NN classification, the output of the classifier is a class membership. In the classification process an object is classified by a common vote of its neighbors, by means of the object being allocated to the class mainly common amongst its k nearest neighbors (*k* must be positive integer value, usually small). If $k = 1$, in that case the object is basically assigned to the class of that single nearest neighbor. K-NN is a type of lazy learning, or instance-based learning, wherever the function is only approximate nearby and all calculation is postponed in expectation of classification. The k-NN algorithm is along with the simplest of every machine learning algorithms. Unlike numerous artificial learners, instance-based learners do not summary at all information as of the training data throughout the learning stage. Learning is simply a query of encapsulating the training data. The course of generalization is delayed until it is totally unavoidable, namely, at the time of classification. This property has directs to the referring to instance-based learners for the reason that lazy learners, while classifiers for instance feedforward neural networks, where accurate abstraction is performed for the duration of the learning phase, frequently are entitled eager learners.

Classification using an instance-based classifier be able to a simple issue of locating the nearest neighbour in instance space and labeling the unidentified instance with the identical class label the same as that of the known neighbour. This approach is frequently referred to as a nearest neighbour classifier. The weakness of this simple approach is the short of robustness that differentiate the resulting classifiers. The high degree of local sensitivity creates nearest neighbour classifiers extremely liable to noise in the training data.Further robust models can be accomplished by locating k, where k > 1, neighbours and hire the majority vote make a decision the result of the class labeling. A high value of k results in a even, a smaller amount nearby sensitive function. The nearest neighbour classifier could be experimental as a particular case of the more general k-nearest neighbours classifier, after this refer to as a KNN classifier. The disadvantage of rising the value of k is of course that as k come up to n, where n is the size of the example base, the performance of the classifier will move toward that of the most simple statistical baseline, the hypothesis that all unidentified examples fit in to the class most often represented in the training data.This difficulty can be stay away from by preventive the control of distant instances. One approach of doing so is to allocate a weight to every vote; in all places the weight is a function of the distance between the unknown and the known example. By leasing each weight be define by the inversed squared distance among the known and unknown instances votes direct by distant instances will have extremely small control on the conclusion process compare to examples in the near neighbourhood. Distance weighted voting frequently serves as a good middle position as far as local sensitivity is worried.

IV. PERFORMANCE MEASURE

When the performance of classifiers are measures, the specificity, sensitivity, positive and negative predictive and classification accuracy values have been used and illustrate in this way. A confusion matrix comprises information concerning actual and predicted classifications completed by a classification scheme. The confusion matrix is exposed in Table 1 (real vs. predicted) and the other parameters which are calculated by means of confusion matrix are given away with the following formula.

$$\text{Specificity (\%)} = \frac{\text{TN}}{\text{FP+TN}} \times 100 \quad (4)$$

$$\text{Sensitity (\%)} = \frac{\text{TP}}{\text{TP+FN}} \times 100 \quad (5)$$

$$\text{Total Classification Accuracy (\%)} = \frac{\text{TP+TN}}{\text{TP+FP+TN+FN}} \times 100 \quad (6)$$

$$\text{Positive Predictive Value (\%)} = \frac{\text{TP}}{\text{TP+FP}} \times 100 \quad (7)$$

$$\text{Negative Predictive Value (\%)} = \frac{\text{TN}}{\text{FN+TN}} \times 100 \quad (8)$$

Total classification Accuracy, specificity, and sensitivity are the words which are mainly generally related with a binary classification test in addition to they statistically assess the performance of the test. In a binary classification, we division a specified data set into two groups on the basis of whether they have familiar properties or not by identify their importance and in a binary classification test, since the name

Published By:
Blue Eyes Intelligence Engineering
and Sciences Publication (BEIESP)

Table1: Confusion Matrix

Real	Predicted	
	Positive	Negative
Positive	True Positive (TP)	False Negative (FN)
Negative	False Positive (FP)	True Negative (TN)

itself suggests, we work with two datasets. Of these two groups, generally, sensitivity specifies, how fine the test forecasts one group and specificity specifies how fine the test predicts the other category. While accuracy is estimated to assess how fine the test predicts both groups. In our research, test sensitivity is the capability of a test to properly recognize those with the disease (true positive rate), while test specificity is the capability of the test to correctly recognize those with no disease (true negative rate). Accuracy specifies correct recognition of both negative and positive cases. Positive predictive value or precision rate is the percentage of positive test results that are true positives (such as correct recognition of disease). Similarly, negative predictive value is defining as the percentage of individuals with a negative test results that are true negative (healthy individuals).

V. RESULT

The central aim of this paper was to recognize how dissimilar classifiers would perform when come across the selected data and to evaluate their performance. In this study, MLP, SVM and KNN have been used for classification of Parkinson's disease. First we analyze the Parkinson database using MLP. For the creation of the architecture of the MLP we progress as follows:

a) Layer 1 represents straightly to the input vector, that is to say, all the parameters fields of the patient's data.

b) Layer 2 represents the hidden layer. The number of neurons for this layer is the mainly involved difficulty in the network's architecture. These numbers signify a trade of among performance and the risk of over fitting. Actually, the quantity of neurons in a hidden layer will extensively control the capability of the network to simplify from the training data to the unidentified instance [23].

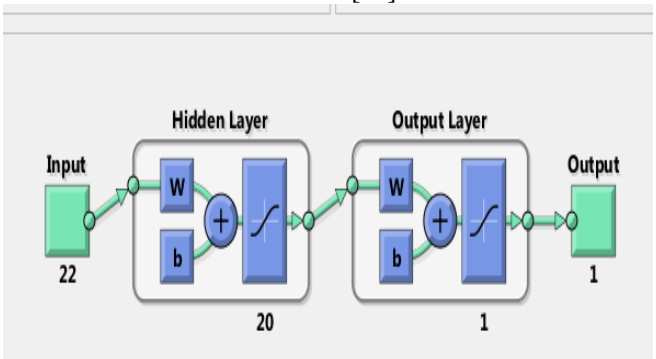

Fig.2: Neural Network Architecture used in our research

c) Layer 3 the output layer classify healthy and ill patients.

Table 3, 4, and 5 represents the confusion matrix for a two class classifier. Total Classification accuracy, sensitivity, specificity, negative predictive value and positive predictive value can be explained by means of the element of the confusion matrix.

Total Classification Accuracy (%) = $\frac{TP+TN}{TP+FP+TN+FN} \times 100$ = 82.35%

Specificity (%) = $\frac{TN}{FP+TN} \times 100$ = 75%

Sensitity (%) = $\frac{TP}{TP+FN} \times 100$ = 84.61%

Positive Predictive Value (%) = $\frac{TP}{TP+FP} \times 100$ = 91.67%

Negative Predictive Value (%) = $\frac{TN}{FN+TN} \times 100$ = 60%

Table 3: Confusion Matrix for MLP

Real	Predicted	
	Positive	Negative
Positive	True Positive (TP) = 22	False Negative (FN) = 4
Negative	False Positive (FP) = 2	True Negative (TN) = 6

KNN is a supervised learning algorithm. KNN classify data by means of nearest neighbor method. The k samples which are nearby to the new sample are originated amongst the training data. The class of the new sample is determined on the basis of the closest k-samples by using majority voting rule with nearest point tie-break [24]. In this paper distance measurements euclidean is used to calculate the distances of the samples to each other.

Euclidean distance: - In this research, database is composed of 22 features is represented in 22 feature space. If A=(a1,a2,,,,a22) and B=(b1,b2,,,b22) are two points in Euclidean 22-space , in that case distance between two points is specified by

$$d(a,b) = \sqrt{\sum_{i=1}^{22}(a_i - b_i)^2} \quad (9)$$

Total Classification Accuracy (%) = $\frac{TP+TN}{TP+FP+TN+FN} \times 100$ = 82.35%

Specificity (%) = $\frac{TN}{FP+TN} \times 100$ = 75%

Sensitity (%) = $\frac{TP}{TP+FN} \times 100$ = 84.61%

Positive Predictive Value (%) = $\frac{TP}{TP+FP} \times 100$ = 91.67%

Negative Predictive Value (%) = $\frac{TN}{FN+TN} \times 100$ = 60%

The SVM classifier with radial basis function (RBF) was implemented in MATLAB (software MATLAB version 8.1, R2013a). This algorithm was applied to the Parkinson's disease dataset. The performances of the implemented classifiers were estimated by calculating the percentage of total classification accuracy (TCA), specificity (SP), sensitivity (SE), positive predictive value (PPE), and negative predictive value (NPV).

Total Classification Accuracy (%) = $\frac{TP+TN}{TP+FP+TN+FN} \times 100$ = 85.294%

Specificity (%) = $\frac{TN}{FP+TN} \times 100$ = 37.5%

Sensitity (%) = $\frac{TP}{TP+FN} \times 100$ = 100%

Positive Predictive Value (%) = $\frac{TP}{TP+FP} \times 100$ = 83.87%

Published By:
Blue Eyes Intelligence Engineering
and Sciences Publication (BEIESP)

Negative Predictive Value (%) = $\frac{TN}{FN+TN} \times 100 = 100\%$

By using these three types of classifiers, not only will it be feasible to make evaluation between them to see which offers the higher precision but also to balance them. In particular, MLP and KNN have a high value of "Positive Predictive Value" equivalent to 91.67% and "specificity" equivalent to

Table 4: Confusion Matrix for KNN

Real	Predicted	
	Positive	Negative
Positive	True Positive (TP) = 22	False Negative (FN) = 4
Negative	False Positive (FP) = 2	True Negative (TN) = 6

Table 5: Confusion Matrix for SVM

Real	Predicted	
	Positive	Negative
Positive	True Positive (TP) = 26	False Negative (FN) = 0
Negative	False Positive (FP) = 5	True Negative (TN) = 3

to 75%. SVM with RBF kernel has the highest value of "Sensitivity" equivalent to 100% and "Negative Predictive Value" equivalent to 100%.Finally, SVM with RBF kernel presents the highest values of "Total Classification accuracy" equal to 85.294%.

Table 6: Comparison of Classifiers

Statistical Features	Classifiers		
	MLP	KNN	SVM
Total Classification Accuracy (%)	82.35	82.35	85.294
Specificity (%)	75	75	37.5
Sensitivity (%)	84.61	84.61	100
Positive Predictive Value (%)	91.67	91.67	83.87
Negative Predictive Value (%)	60	60	100

VI. CONCLUSION

Brain is the mainly significant part of human body the performance of further body parts based on brain. Computer give support to detection and diagnosis algorithms which have been developed to assist radiologists and give an precise diagnosis and to decrease the number of mistaken decisions concerning the Parkinson diseases. In this paper we have evaluated the performance of a classifier build by means of ANN, KNN and SVM. The consequences offered by these three methods have both a high accuracy of the confusion matrix concerning the different measurement parameters (sensitivity, specificity, total classification accuracy, negative predictive value and positive predictive value). In this research SVM obtains total accuracy of classification equals to 85.294%. We think that the developed system can be extremely supportive to the physicians as a second view for their final conclusion. By using such an capable tool, they can create very perfect decisions. We have originated that the imbalanced data and outliers straightly exaggerated the efficiency of the classifiers and classification performance. There are 23 registers with PD and 8 healthy ones. The accurateness of the classifiers will be enhanced by reducing a number of outliers from both the majority and minority classes, and growing the size of the minority class to the equal size of the majority class

ACKNOWLEDGMENT

We desire to convey our acknowledgements to Max Little of the University of Oxford, who has produced the record, in association with the National Centre for Voice and Speech, Colorado and Denver who record the speech signals.The original learning accessible in the feature extraction techniques for general voice disorders.

REFERENCES

1. Beal, "Experimental models of Parkinson's disease", Nature Reviews Neuroscience, 2, 325–334, 2001.
2. A.H. Hadjahmadi & Taiebeh J. Askari, "A Decision Support System for Parkinson's Disease Diagnosis using Classification and Regression
3. Betarbet, R., Sherer, T. B., & Greenamyre, J. T., "Animal models of Parkinson's disease. Bioessays", 24, 308–318, 2002.
4. Manciocco, A., Chiarotti, F., Vitale, A., Calamandrei, G., Laviola, G., & Alleva, E., "The application of Russell and Burch 3R principle in rodent models of Neurodegenerative disease: The case of Parkinson's disease", Neuroscience and Biobehavioral Reviews, 33, 18–32, 2009.
5. E. Tolosa, G. Wenning, and W. Poewe, "The diagnosis of Parkinson's disease", Lancet Neurology, 5(1):75{86, 2006.
6. Singh, N., Pillay, V., & Choonara, Y. E., "Advances in the treatment of Parkinson's disease. Progress in Neurobiology", 81, 29–44, 2007.
7. Little, M. A., McSharry, P. E., Hunter, E. J., Spielman, J., & Ramig, L. O., "Suitability of dysphonia measurements for telemonitoring ofParkinson's disease", IEEE Transactions on Biomedical Engineering, 2008.
8. Anchana Khemphila, Veera Boonjing, "Parkinsons Disease Classification using Neural Network and Feature selection", World Academy ofScience & Tech, 64, 2012.
9. J. Jankovic, A.H. Rajput, M.P. McDermott, and D.P. Perl, "The evolution of diagnosis in early Parkinson disease", Mar; 57 (3), 369-72, 2000.
10. Valluru B. Rao and Hayagriva Rao. 1995. C++, Neural Networks and Fuzzy Logic (2nd Ed.). MIS: Press, New York, NY, USA.
11. Alexander I. Galushkin. 2007. Neural Network Theory. Springer-Verlag New York, Inc., Secaucus, NJ, USA.
12. Shigeo Oyagi, Ryoichi Mori, Noriaki Sanechika Realization of a Boolean function using an extended threshold logic. Bulletin of the Electro technical Laboratory, Vol: 42, PP: 9–74, 1978.
13. I.A.Basheer, M.Hajmeer, Artificial neural networks: fundamentals, computing, design, and application, J.Microbiol. Meth. Vol:43, PP: 3–31, 2000.
14. B.B.Chaudhuri, U.Bhattacharya, ENcient training and improved performance of multilayer perceptron in pattern classification, Neurocomputing, Vol:34, pp: 11-27, 2000.
15. Hanbay, D., Turkoglu, I., & Demir, Y. (2008). An expert system based on wavelet decomposition and neural network for modeling Chua's circuit. Expert Systems with Applications, Vol: 34, No:4, Pp: 2278–2283.
16. Tran Nguyen, Richard Malley, Stanley H. Inkelis, Nathan Kuppermann, Comparison of prediction models for adverse outcome in pediatric meningococcal disease using artificial neural network and logistic regression analyses, Journal of Clinical Epidemiology, Vol: 55, No: 7, Pp: 687-695, 2002

Published By:
Blue Eyes Intelligence Engineering and Sciences Publication (BEIESP)

17. Center for Machine Learning and Intelligent Systems (2008)http://archive.ics.uci.edu/ml/datasets/Parkinsons
18. B.D. Ripley. Pattern recognition and neural networks. Cambridge university press, 1996.
19. S. Haykin. Neural Networks: A Comprehensive Foundation, Englewoods Cli®s, 1998.
20. CM Bishop. 1995, Neural Networks for Pattern, Recognition, Oxford: Oxford University Press.
21. C.J.C. Burges. A Tutorial on Support Vector Machines for Pattern Recognition. Data Mining and Knowledge Discovery, 2(2):121{167, 1998.
22. C. Cortes and V. Vapnik. Support-vector networks. Machine Learning, 20(3): 273{297, 1995).
23. M. Pal and University of Nottingham (GB). Factors Influencing the Accuracy of Remote Sensing Classification: A Comparative Study. University of Nottingham, 2002.
24. Chih-min ma, Wei- Shui Yang and Bor-Wen Cheng "How the Parameters of K-nearest Neighbor Algorithm Impact On The Best Classification Accuracy: In Case Of Parkinson's Disease " Journal of Applied Science 14(2):171-176, 2014.

AUTHOR PROFILE

Aprajita Sharma received the B.E. degree from Chhattisgarh Swami Vivekanand Technical University (Bhilai), Chhattisgarh in 2010 and pursuing M.tech degree in Computer Science Engineering from Raipur Institute of Technology, Raipur, (C.G.) affiliated to Chhattisgarh Swami Vivekanand Technical University, Bhilai (Durg). Her area of research is Artificial Neural Network, Artificial Intelligence and Image Processing.

Ram Nivas Giri is assistant professor in department of computer science and engineering, Raipur Institute of Technology, Raipur, (C.G). His research interests include Digital Signal Processing and Image Processing, Artificial Neural Network, Artificial Intelligence, Information and Network Security.