International Conference on Substantial Development in the field of Engineering and Management
Mahratta Chamber of Commerce, Industries and Agriculture Tilak Road, Pune (India)
29th December 2019 www.conferenceworld.in ISBN : 978-81-943584-8-0

Optimized techniques to determine the efficiency of Chronic Kidney Diseases diagnosis using Artificial Neural Network

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Abstract

Today Chronic Kidney diseases is one of the most widespread diseases in developing countries like India, Statistics of Kidney diseases are increased approximately to 15% compared to the last decades. Clinical diagnosis of chronic kidney diseases mainly focused on blood, urine test as well as removing a sample of kidney for testing. Early precautions are needed to stop the failure of kidney functionalities. Optimized techniques are implementing in this paper to determine the efficiency of chronic kidney diseases diagnosis using artificial neural network.

Keyword: *Artificial Neural Network, Chronic Kidney Diseases, Back propagation, Radia Basis Function, Random Forest.*

1. Introduction

Kidney is essential organ in human body. This has main functionalities like excretion and osmoregulation. In simple words we can say that all the toxic and unnecessary material from the body is collected and thrown out by kidney and excretion system. There are approximately 1 million cases of Chronic Kidney Disease (CKD) per year in India. Chronic kidney disease is also called renal failure. It is a dangerous disease of the kidney which produces gradual loss in kidney functionality. CKD is a slow and periodical loss of kidney function over a period of several years. A person will develop permanent kidney failure.

If CKD is not detected and cured in early stage then patient can show following Symptoms: Blood Pressure, anaemia, weekboans, poor nutrition health and nerve damage, Decreased immune response because at advanced stages dangerous levels of fluids, electrolytes, and wastes can build up in your blood and body. Hence it is essential to detect CKD at its early stage but it is unpredictable as its Symptoms develop slowly and aren't specific to the disease. Some people have no symptoms at all so machine

ISBN : 978-81-943584-8-0

learning can be helpful in this problem to predict that the patient has CKD or not. By using old CKD patient data to train predicting model. Glomerular Filtration Rate (GFR) is the best test to measure your level of kidney function and determine your stage of chronic kidney disease. It can be calculated from the results of your blood creatinine, age, race, gender, and other factors. The earlier disease is detected the better chance of showing or stopping its progression. Based upon GFR the renal damage severity by CKD is categorized.

2. Literature Survey

The following survey had been determined based on the proposed work are as follows

- Gunarathne W.H.S.D et.al. Has thought about consequences of various models. Lastly they presumed that the Multiclass Choice woods calculation gives more exactness than different calculations which is around 99% for the diminished dataset of 14 qualities.
- S.Ramya and Dr.N.Radha took a shot at analysis time and improvement of conclusion exactness utilizing distinctive order calculations of AI. The proposed work manages order of various phases of CKD as indicated by its gravity. By dissecting various calculations like Essential Proliferation Neural System, RBF and RF. The investigation results shows that RBF calculation gives preferred outcomes over different classifiers and produces 85.3% exactness.
- S.Dilli Arasu and Dr. R. Thirumalaiselvi has taken a shot at missing qualities in a dataset of constant Kidney Illness. Missing qualities in dataset will decrease the precision of our model just as forecast results. They discover arrangement over this issue they played out a recalculation procedure on CKD stages and by doing so they got up with obscure qualities. They supplanted missing qualities with recalculated esteems.
- Asif salekin and john stankovic they utilize novel way to deal with recognize CKD utilizing AI calculation. They get result on dataset which having 400 records and 25 characteristics which gives aftereffect of patient having CKD or not CKD. They use k-closest neighbors, irregular timberland and neural system to get results. For include decrease they use wrapper technique which recognize CKD with high precision.
- Pinar Yildirim look through the impact of class awkwardness when we train the information by utilizing advancement of neural system calculation for settling on therapeutic choice on interminable

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kidney infection. In this proposed work, a similar report was performed utilizing inspecting calculation. This examination uncovers that the presentation of order calculations can be improved by utilizing the testing calculations. It additionally uncovers that the learning rate is a critical parameter which essentially impact on multilayer perceptron.

- Sahil Sharma, Vinod Sharma, and Atul Sharma, has surveyed 12 distinctive order calculation on dataset which having 400 records and 24 characteristics. They had contrasted their determined outcomes and genuine outcomes for computing the exactness of expectation results. They utilized evaluation measurements like exactness, affectability, accuracy and explicitness. They find that the choice tree procedure surrenders exactness to 98.6%, affectability of 0.9720, and accuracy of 1 and explicitness of 1.

3. Methodologies

This proposed work mainly classified into three types of process such as input mainly focus on the data provided based on Chronic Kidney diseases. Output process show the efficiency of the optimized techniques. The Hidden layer mainly focused on the process of artificial neural network such as back propagation method, radial Basis function and Random forest as shown in Figure 3.1.

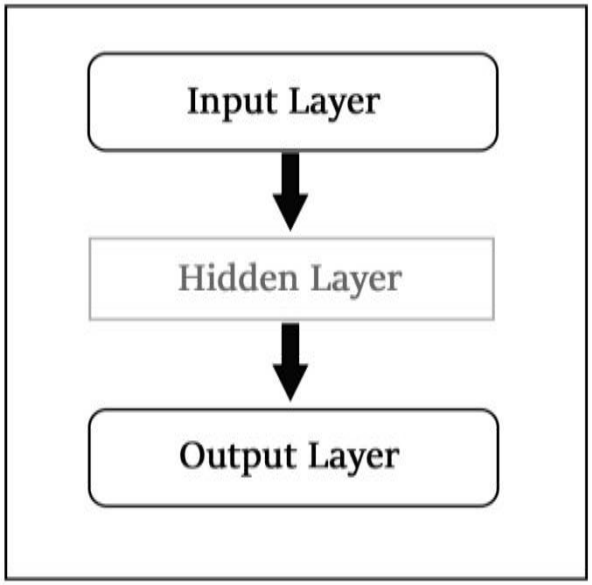

Figure 3.1: Process of the Proposed work

Four types of Methodologies are used in the proposed work as shown in Figure 3.2

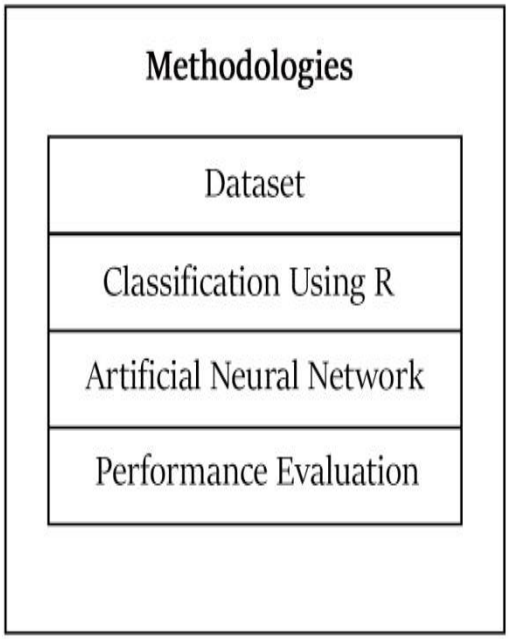

Figure 3.2 Methodologies

First Stage are Data set, which mainly focused on raw data set act as input to the proposed optimized techniques. Second Classification of Data set using R concept based on the clustering. Third methodologies are mainly focused on Artificial Neural Network,. Which are further classified into three types of algorithm such as Back Propagation Method, Radial Basis Function and Random Forest. The Fourth Methodologies focused on performance evaluation based on the optimized result obtained with efficiency.

4. Architecture Diagram

The architecture diagram includes three parts as discussed in methodologies which shown in Figure 4.1.

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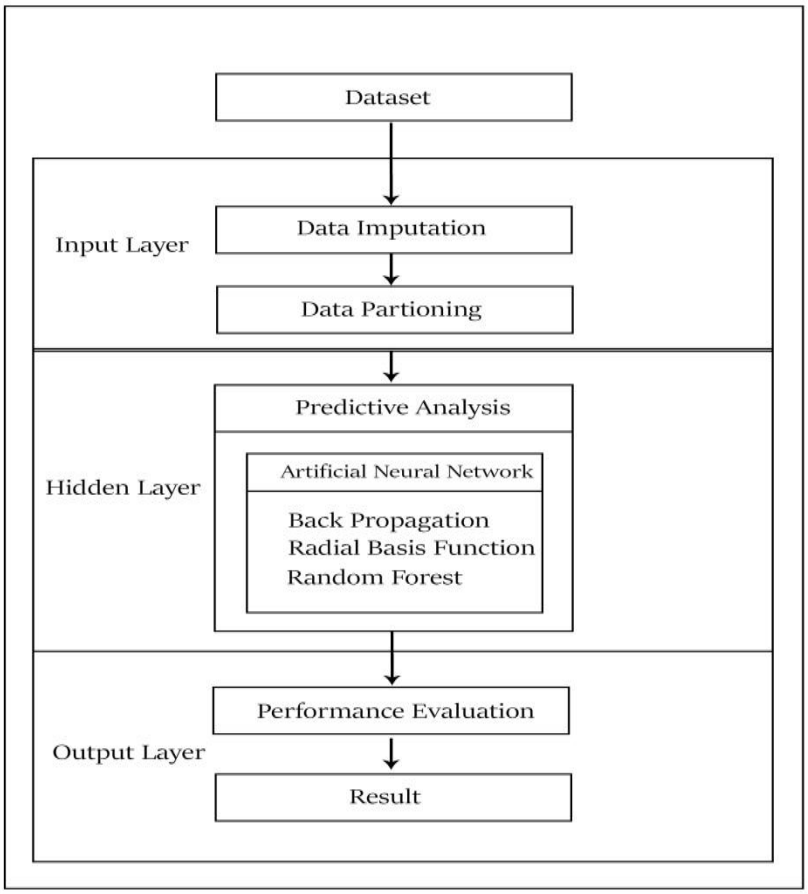

Figure 4.1 Architecture Diagram

- **Input Layer: Data imputation** which referred as calculating the mean/median of the non-missing values in a column and then replacing the missing values within each column separately and independently from the others. It can only be used with numeric data**. Data Partitioning** which is used to partition the data set based on the clustering concept.
- **Hidden Layer:** This layer mainly focused on the predictive analysis using the proposed tools which help to determine the next level of thinking using artificial intelligence. For predictive analysis, three methods are implemented to determine the proposed objective tools such as Back Propagation Method, Radial basis Function and Random Forest.

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- **Output Layer:** This layer will provide the result of the proposed techniques which will be compared with other existing tools based on the performance evaluation will leads to be very effective.

5. Proposed optimized Techniques

The proposed strategies for the optimized techniques are shown in the Figure 5.1 below.

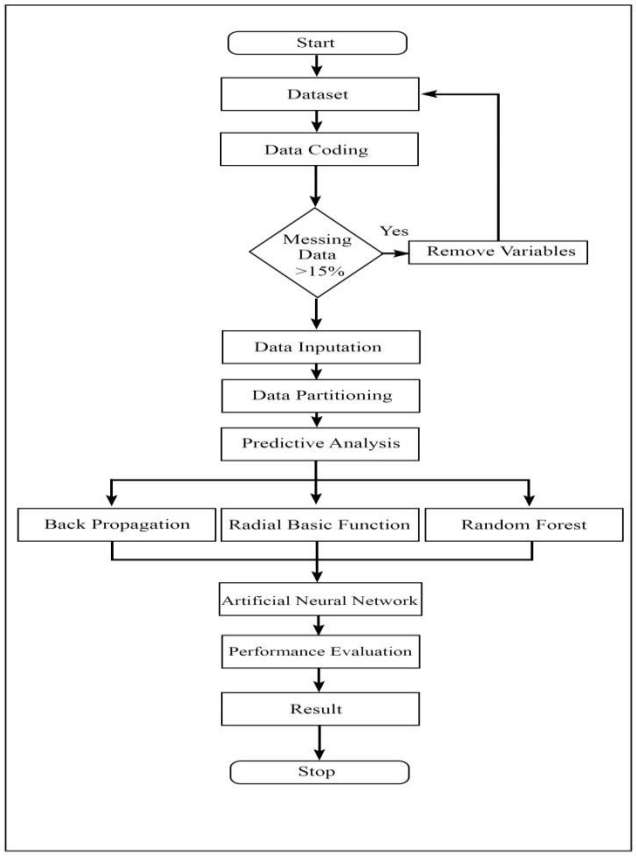

Figure 5.1 Proposed Techniques.

The following steps are involved in the proposed techniques are as follows

Step 1: Input to the proposed techniques is data set of Chronic Kidney Disease.

Step 2: Data Coding, where marshaling techniques are implement which used to convert data into prescribed format.

Step 3: If Data is greater than 15%, then remove the data.

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Step 4: Data imputation process will be process at this stage

Step 5: Data are partitioned at this level

Step 6: Predictive analysis leads to The hidden layers are between the input and output neurons and correspondingly a large number of weights. The weights are the key elements in an artificial neural network. They express the relative strength of the input data. The summation function computes the weighted sums of all the input elements entering each processing element

A summation function multiplies each input value by its weight and totals the values for a weighted sum Z. The formula for n inputs are determined as

$Z = \sum_{i=1}^{n} Xi.wi$ → A

For the j th neuron of several processing neurons in a layer the formula is

$Z = \sum_{i=1}^{n} Xi.wij$ →B

$Z_T = 1/ (1 + e^{-Y})$→C

From Equation A,B, C predictive analysis can be performed.

Step 7: Back propagation method act as supervised learning artificial neural algorithm are implemented at this level

Step 8: Radial Basis Function based on the squared Euclidean distance between the input vector and the weight vector and uses exponential activation functions in the hidden layer

Step 9: Random Forest uses both bagging and random variable selection for tree building

Step 10: Performance Evaluation are calculated below based on the basic four principles such as Kappa, Specificity, Sensitivity and Accuracy

Step 11: Proposed Optimized tools leads to the efficiency in terms of result to determine the Chronic kidney diseases.

Step 12: Stop the process

6. Performance evaluation

The performance evaluation measures like kappa, specificity, sensitivity and accuracy are given for each classifier in detail. Kappa Statistic is used to evaluate the accuracy of any particular measuring cases

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which is used to distinguish between the reliability of the data collected and their validity. Table 6.1 determine the values of Back propagation method, Radial Basis Function and Random Forest as shown below.

Classification/ Performance	**BP**	**RF**	**RBF**
Kappa	0.81	0.81	0.82
Specificity	0.84	0.87	0.86
Sensitivity	0.82	0.84	0.83
Accuracy	80.40%	78.60%	85.30%

Table 6.1 Comparasion.

- **The Kappa score** for the Radial Basis Function is 0.8170. The Radial Basis Function provides better result.
- **The Sensitivity and Specificity** measures are used to calculate the true positive rate and true negative rate. **The value of sensitivity** for Back Propagation Neural Network it is 0.8243, Random Forest attained 0.8447 and Radial Basis Function obtained 0.8406.
- **The value for specificity** for Back Propagation Neural Network is 0.8410, Random Forest obtained 0.8782 and Radial Basis Function gained 0.8633. Figure. 6.1 illustrates the chart comparison of different classifiers like back propagation, radial basis function and random forest with performance analysis of kappa, sensitivity specificity.

Demonstrate the accuracy comparison of algorithms

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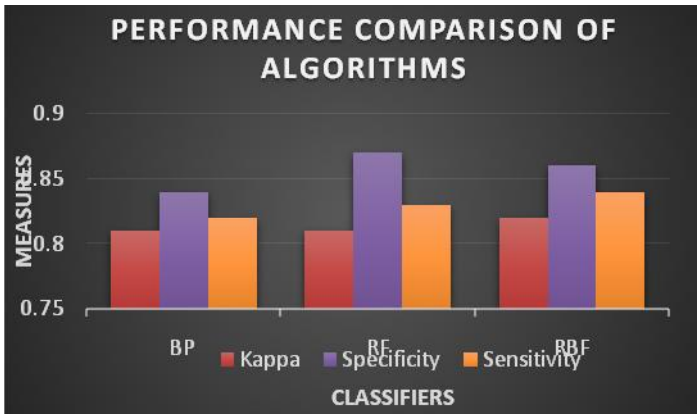

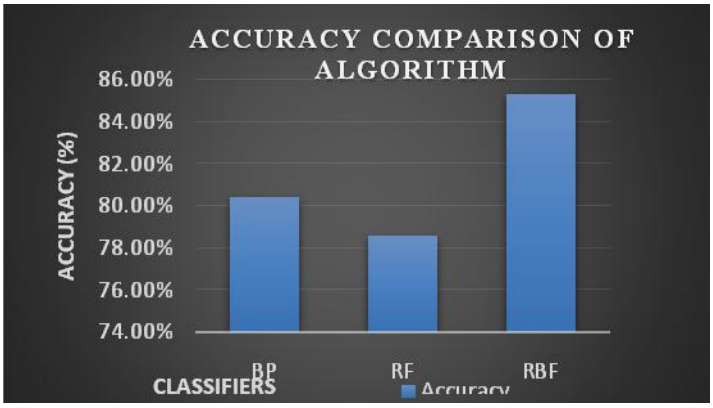

7. Conclusions

This proposed work concluded that forecast of constant kidney diseases is one of the basic themes in medicinal conclusion. The proposed work is to group the various phases of constant kidney illness as per its seriousness. The grouping calculations that have been considered for anticipating incessant kidney sickness are Back proliferation Neural System, Outspread Premise Capacity and Irregular Woodland. The models are assessed with four distinct estimates like Kappa, specificity, sensitivity and accuracy. From the exploratory outcome, the Spiral Premise Capacity is the better exactness for foreseeing ceaseless kidney infection and it achieves the precision of 85.3%.

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