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Efficient Heart Disease Prediction with Artificial Neural Network, Radial Basis Function and Case Based Reasoning

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Abstract: Heart disease is one of the most hazardous diseases to human which shows the way to death all over the world since 15 year. Many researches have been done with the techniques of knowledge discovery in various fields for heart disease prediction and have shown the acceptable levels of accuracy. By investigating the survey of those accuracy levels, this research paper is proposed to help doctors not only to diagnose and predict the heart disease by achieving accuracy levels but also helps to prescribe the medicine successfully according to the predicted disease. In this paper assessment is done by two methodologies Artificial Neural Network (ANN) by testing the datasets, Case Based Reasoning (CBR) image similarity search by mapping the similarities of images of old patients stored in database for prediction of heart disease. The result of the evaluation of CBR is also implemented for prescribing medicine from the history of old patients with generalized regression neural network and radial basis function successfully.

Key words: Artificial Neural Network (ANN), Case Based Reasoning (CBR), Generalized Regression Neural Network (GRNN), Radial Basis Function (RBF), data base

INTRODUCTION

Cardiovascular disease has become the major challenge for health care unit (doctors, medical centres, hospitals). Cardiovascular disease or heart disease is a class of disease that involves the heart, blood vessels (arteries, capillaries and veins) (WHO, 2016; Tsai and Watanabe, 1998). The American heart association has estimated that 17.3 million people die because of cardiovascular disease per year, particularly heart attacks, strokes, coronary heart disease, pulmonary heart disease, etc. (WHO, 2016). This global cause of death can increase the number to grow >23.6 million by 2030.The populations affected by heart diseases are mostly in Low and Middle-Income Countries (LIMC) where 80% of these deaths occur usually at younger ages than in higher income countries (Tsai and Watanabe, 1998).

To prevent the cause of death in LIMC and reduce in number, diagnosis and prediction is very important but it has never been an easy task for accurate diagnosis of heart diseases. Lots of research is being done for diagnosis of heart disease but still the complications in various factors are causing delay in diagnosis of heart disease and deciding the accuracy. Like for instance the symptoms from clinic, the practical and pathological symptoms of heart diseases are linked with the human organs including heart which shows signs of different diseases in human body. Perhaps, these signs have similar symptoms of heart diseases as well. Researchers are facing difficulties to find accuracy not only in diagnosis but also in prescribing the correct medicine for the particular symptom of heart diseases.

From the survey of different researchers, various techniques have been used for diagnosis. Recently integrated clustering more than one data mining techniques can improve data mining techniques performance in the diagnosis of heart disease patients (Shouman *et al*., 2013). For the diagnosis of congenital heart disease. Reategui *et al*. (1997) proposed a model by integrating case-based reasoning with neural network. Fuzzy reasoning optimized by genetic algorithm was used for the classification of myocardial heart disease (Tsai and Watanabe, 1998). All the above studies by implementing different techniques are able to diagnose the heart disease to a certain extent either for one specific heart disease or for some common heart diseases. But no research has been done which identifies the heart disease with utmost accuracy and also a technique which helps the doctors to provide the suitable treatment with the right prescription of medicine.

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Table 1: A sample of different neural network and data mining techniques used on heart disease diagnosis

Resarchers	Technique	Accuracy (%)
Polat *et al.* (2007)	Fuzzy-AIRS-K-nearest neighbour	87
Das *et al.* (2009)	Neural network ensembles	89.01
Hannan *et al.* (2010)	GRNN and RBF for Heart disease diagnosis	93 of medicine prediction
Awang and Siraj (2013)	ANN	84
Shouman *et al.* (2012)	2 Cluster Inlier K = 19 Nearest neighbour	85.7

The proposed methodology is separated with two schemes one is neural network method which is integrated with Case Based Reasoning (CBR) data mining techniques with similarity search algorithm to diagnose the heart disease with accuracy. And the second is integrating CBR data mining technique with Generalized Regression Neural Network (GRNN) and radial basis function to prescribe the medicine.

Brief background about the related previous works: The survey shows that several researchers are using various techniques like data mining and neural networks, etc., to identify the risk factors associated with heart disease. Statistical scrutiny has identified the risk factors related to heart disease to be age, blood pressure, cholesterol smoking (Heller *et al*., 1984), diabetes (Simons *et al*., 2003), high blood pressure with cholesterol levels, family history of heart disease (Salahud and Rabbi, 2006), obesity, physical inactivity (Shahwan-Akl, 2010), high stress, poor hygiene. Knowledge of the risk factors associated with heart disease helps health care professionals to identify patients at high risk of having heart disease. Hospitals, doctors, health care systems and health care professionals store considerable data about the patients and it is necessary to analyze these datasets to extract useful knowledge. Different techniques have been implemented to analyse this datasets and diagnose heart disease.

Artificial neural networks and data mining techniques have been used to help health care professionals in the diagnosis of heart disease and also to predict the medicine for heart disease. Recently GRNN and RBF are used for the function of heart disease diagnosis and the medicine data is prescribed. Experimental analysis was made for first five patients (Tsai and Watanabe, 1998). Data mining can play an important role in the diagnosis of heart disease patients. Clustering techniques were implemented in data mining techniques presently for the diagnosis of heart disease (Shouman *et al*., 2013). Awang and Siraj (2013) used an artificial neural network in the prediction of heart disease particularly angina in patients (Shouman *et al*., 2013). Qeethara Kadhim Al-shayea used artificial neural network in medical diagnosis (WHO, 2016). Polat *et al*. (2007) analyzed Automatic detection of heart disease using an Artificial Immune Recognition System (AIRS) with fuzzy resource allocation mechanism and k-nearest neighbour for heart disease. Das *et al*. (2009) and Simons *et al*. (2003), effective diagnosis of heart disease through neural networks ensembles.

Researchers used various artificial neural network and data mining techniques for heart disease diagnosis and prediction as explained above. Table 1 illustrates the sample of those techniques in the heart disease diagnosis and prediction with their level of accuracy. All these investigations cannot be compared because they have used different datasets, unique techniques for the diagnosis and have shown the accuracies.

But with this datasets and techniques accuracy levels can be improved. The above results of researches have produced very good results in the heart disease diagnosis. But further investigations are necessary to improve the diagnosis of heart disease and prediction to help the health care professionals. The proposed methodology is used to increase the level of research accuracy in of heart disease diagnosis and prediction of medicine comparatively. The next part of the paper explains about the techniques.

A brief explanation about the techniques used ANN: Artificial Neural Networks (ANN) is currently a ‘hot’ research area in medicine and it is believed that they will receive extensive application to biomedical systems in the next few years. At the moment, the research is mostly on modeling parts of the human body and recognizing diseases from various scans (e.g., cardiograms, CAT scans, ultrasonic scans, etc.,). Neural networks are ideal in recognizing diseases using scans since there is no need to provide a specific algorithm on how to identify the disease. Neural networks learn by example so the details of how to recognize the disease are not needed. What is needed is a set of examples that are representative of all the variations of the disease. The quantity of examples is not as important as the ‘quantity’. The examples need to be selected very carefully if the system is to perform reliably and efficiently.

CBR: CBR solves problems using the already stored knowledge and captures new knowledge, making it immediately available for solving the next problem. Therefore, case-based reasoning can be seen as a method for problem solving and also as a method to capture new

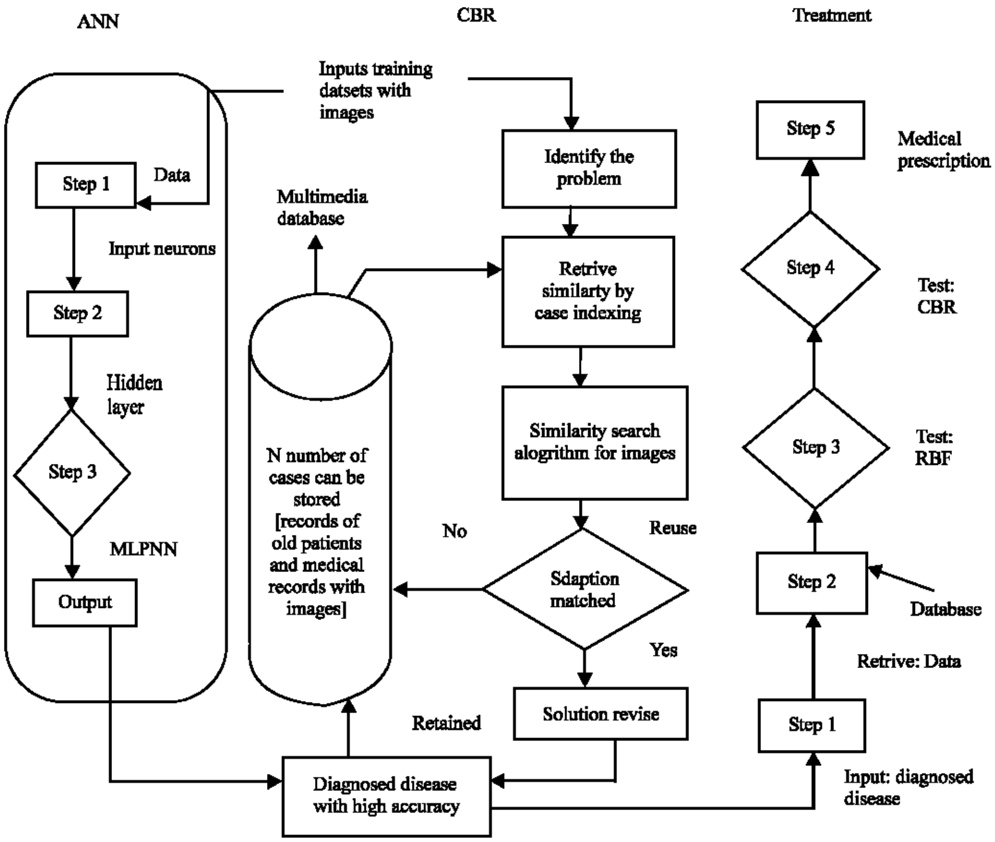

Fig. 1: Proposed approach

experience and make it immediately available for problem solving. It can be seen as a learning and knowledge-discovery approach, since it can capture from new experience some general knowledge such as case classes, prototypes and some higher-level concept.

CBR four-step process

Retrieve: Given a target problem, retrieve from memory cases relevant to solving it.

Reuse: Map the solution from the previous case to the target problem.

Revise: Having mapped the previous solution to the target situation, test the new solution in the real world (or a simulation) and if necessary, revise.

Retain: After the solution has been successfully adapted to the target problem, store the resulting experience as a new case in memory.

GRNN and RBF: The General Regression Neural Network (GRNN) is a one-pass learning algorithm with a highly parallel structure. It is shown that, even with sparse data in a multidimensional measurement space, the algorithm provides smooth transitions from one observed value to another.

A radial basis function network is an artificial neural network that uses radial basis functions as activation functions. The output of the network is a linear combination of radial basis functions of the inputs and neuron parameters (Fig. 1).

MATERIALS AND METHODS

Neural Network implementation: An artificial neural network is a computational network model (neurons) that are massively interconnected, operate in parallel. These elements are inspired by biological nervous system. The connections between elements largely determine the network function. Medical diagnosis using artificial neural networks is currently a very active research area in medicine and it is believed that it will be more widely used in biomedical systems.

Data preparation: The data preparation is the important part to determine the best variables that contribute to define the optimal solution. This requires the detailed

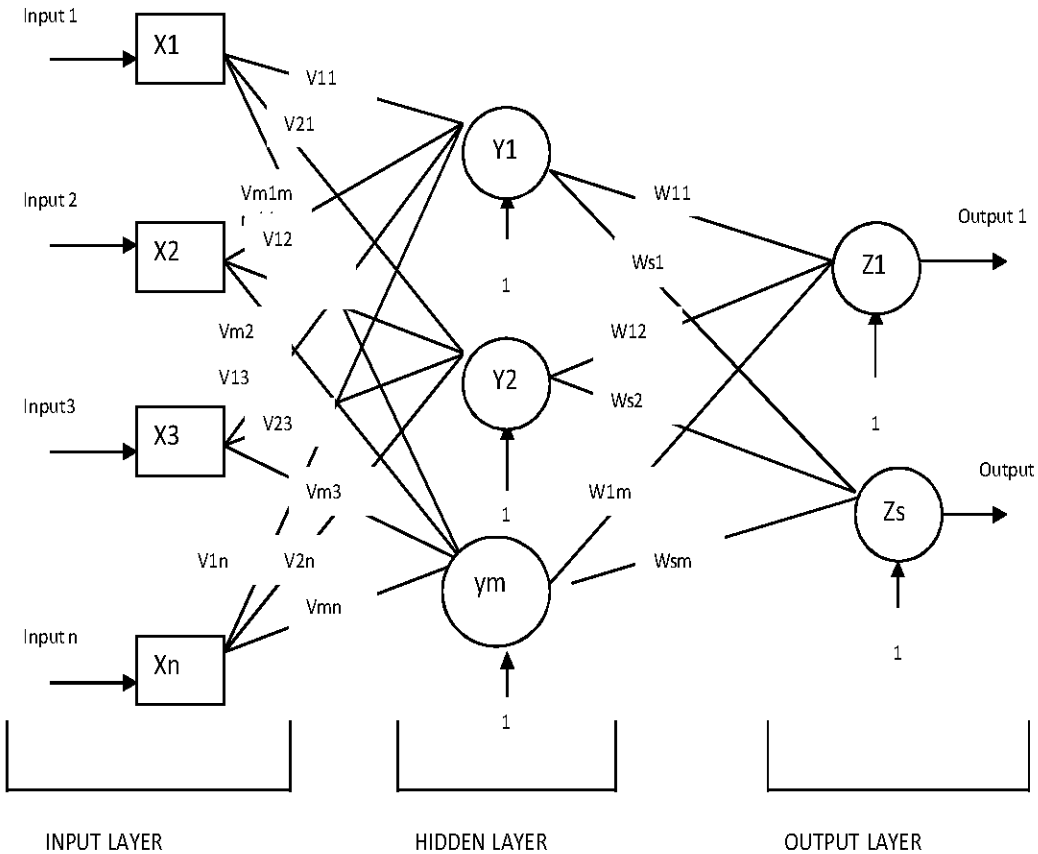

Fig. 2: Multilayer perceptron neural network

knowledge about the problem domain and the primary data's. Here, the selection of this primary data is based on the doctor's suggestions and the survey of the literatures. The data's total, 910 records with 16 medical aspects were taken from cleveland heart disease database. The dataset consists of 78 raw attributes which experiments refer to 16 of them. The attributes which is used in this study is given in Table 2 with their parameters and weights.

The neural network is trained with the significant dataset or attributes as their inputs for the efficient heart disease prediction. The prediction is based on the computed major weights given in Table for each attribute. In ANN the processing element is called a layer. The first layer is the input layer and the last layer is called the output layer. Between the input and the output layer the additional layers of units is called as hidden layer. A function can be performed by adjusting the values of the weights between elements.

MLPNN algorithm and prediction: Figure 2 shows the structure of MLPNN with the layers were the significant inputs to heart disease prediction have been used with their weights given in Table 2. In which 0.1 refers to the lower risks and >0.1 refers to the higher risks. Here, for the prediction of the heart disease the Multi-Layer Perceptron Neural Network [MLPNN] with back propagation is being used as the training algorithm. This is done in a unidirectional way. In a feed forward neural network mechanism, the input neurons of the first layer $[X_1, X_2, X_3, \ldots, X_n]$ forward their output to the neurons of the second layer as $[V_{11}, V_{21} \ldots]$ from Which hidden layer $[Y_1, Y_2, \ldots, Ym]$ evaluates the weights $[W_{11}, W_{22}, \ldots \ldots]$ and gives the output layer as [z1…]. By using this MLPNN algorithm heart disease diagnosis is done with the input attributes and the weights given in Table 2. The back propagation equation which is represented is used for MLPNN back propagation neural network:

$$\Delta Wxz_m = \varepsilon \delta z_p a x_q \tag{1}$$

$$\delta z_p = az_p(1 - az_p)(tz_p - az_p) \quad \text{if output node} \tag{2}$$

$$\delta z_p = az_p(1 - az_p)\sum_{i=0} \delta yiWzyi \text{ if intermediate node} \tag{3}$$

Table 2: Heart attack attributes their values and weights

Attributes	Description	Weights
Age for both male and female	Age<30	0.1
	30-50	0.4
	50-70	0.7
	>70	0.9
Family history	Yes	0.5
	No	0.1
Chest pain	Type: typical	0.6
	angina	0.7
	atypical angina	0.8
	non-angina pain	0.9
	asymptomatic	
Smoking	Never	0.1
	Past	0.4
	Current	0.7
Poor diet	Yes	0.9
	No	0.2
Trestbps (blood pressure) in mm Hg	Normal (130/89)	0.1
	Low (<119/79)	0.8
	High (>200/169)	0.9
Blood sugar (Fbs)	High (>120 and <400)	0.6
	Normal (>90 and <120)	0.1
	Low (<90)	0.4
Serum cholesterol (mg dL^{-1})	Very high >200	0.9
	High 160-200	0.8
	Normal <160	0.1
Thalach (heart rate)	High	0.9
	Normal	0.1
	Low	0.9
Exang (exercise)	Never	0.7
	Regular	0.1
	High if age <30	0.1
	High if age >50	0.8
Physical inactivity	Yes	0.8
	No	0.2
Obesity	Yes	0.8
	No	0.1
High stress	Yes	0.7
	No	0.2
Poor hygiene	Yes	0.6
	No	0.2
Alcohol intake	Yes	0.7
	No	0.2
Restecg (Resting electrocardiographic results)	Having ST-T-wave abnormality	0.6
	Showing probable or define left ventricular hypertrophy	0.8

Where:

x = The emitting node
z = The receiving node
y = The layer which follows z
W = Weight, a is for activation, delta values with eplilon as the learning rate

RESULTS AND DISCUSSION

The result obtained from the above experiment gives the 89-90% accuracy of heart disease. But with this only above experiment the heart disease cannot be predicted with the high accuracy and including the type of heart disease to prescribe the medicines. So to predict the type of heart disease with the high accuracy and to prescribe medicine we integrate this with the CBR technique which is the next part of this study.

Case Based Reasoning (CBR) with similarity Search algorithm

CBR: Case-based reasoning means using old experiences to understand and solve new problems. In case-based reasoning, a reasoner remembers a previous situation similar to the current one and uses that to solve the new problem. The same method here we use for heart disease prediction and to prescribe medicine.

Multimedia database: The multimedia database systems are to be used when it is required to administrate huge amounts of multimedia data objects of different types of data media. The objects of multimedia data are text, images. Graphics, sound recordings, video recordings, signals, etc. that are digitalized and stored.

In CBR multimedia database n number of cases are collected and stored. The cases like old records of heart disease patients, medical records about the disease were stored in database. Perhaps each record consists of (patient name, patient no, symptoms, type of heart disease, doctors name, hospital name, prescriptions and especially images of the affected heart, etc).

Input attributes: The same dataset which we had taken as symptoms in neural network approach is in use for Case Based Reasoning approach as well. In this CBR similarity search technique including the above symptoms we use images of heart of the patient as an input to find out the similarity with previous records and predict whether the patient is affected by the heart disease or not, if so then what type of heart disease. The steps for CBR similarity search with multimedia database are as follows.

Step 1: Identify the problem: First step in CBR technique is to identify the problem of the patient with the input attributes (symptoms) including the images of heart of the patient were his disease is to be predicted.

Step 2: Retrieve similarity by case indexing: Given a target problem, retrieve from memory cases relevant to solving it. Second step is to retrieve the similarity from the previous old patient records or medical records by case indexing with the present patient. An index is a computational data structure that can be stored in memory and searched quickly. Case indexing involves assigning indexes to cases to facilitate their retrieval.

Case retrieval is a process that a retrieval algorithm retrieves the most similar cases to the current problem. Case retrieval requires a combination of search and matching. Two retrieval techniques are used by the major CBR to diagnose the similarity for heart disease prediction: nearest neighbor retrieval algorithm and inductive retrieval algorithm.

Nearest-neighbor retrieval is a simple approach that computes the similarity between stored cases and new input case based on weight features. A typical evaluation function is used to compute nearest-neighbor matching:

$$\text{Similarity}(\text{Case}_I, \text{Case}_R) = \frac{\sum_{i=1}^{n} w_i \times \text{sim}(f_i^I f_i^R)}{\sum_{i-1}^{n} w_i} \quad (4)$$

Where:

w_i = The important weight of a attribute
sim = The similarity function of attribute
f_i^I and f_i^R = The values for attributes (symptoms)
i = The input and retrieved cases, respectively

This retrieval is simple and slow when the case based is large. Inductive retrieval algorithm is a technique that determines which features do the best job in discriminating cases and generates a decision tree type structure to organize the cases in memory. This approach is very useful when a single case aspect is required as a solution and when that case attribute is dependent upon others.

This algorithm is fast retrieval process. But this process is pre-indexing which is a time-consuming and impossible to retrieve a case while case data is missing or unknown. These algorithms are used according to the type of search fast or slow.

Step 3: Similarity search for images): Third step is one of the most important steps which is used to compare and predict the similarity between the input image of the heart disease patient with the images of previous old patient and medical records. Here the images of the affected patient are taken to predict the similarity with the images in CBR by K-N Match AD similarity search algorithm.

The AD algorithm for K-N match search: The k-n-match problem models similarity search as matching between the query object and the data objects in n dimensions where n is a given integer smaller than dimensionality d and these n dimensions are determined dynamically to make the query object and the data objects returned in the answer set match best. In this study we implement this for matching the similarity between the images of the heart patient.

Algorithm:

```
Algorithm KNMatchAD
Initialize appear[ ], h and S
For every dimension i
Locate qi in dimension i
Calculate the differences between qi
   and                        its closest attributes in dimension i

   along both directions.
   Form a triple (pid; pd;  dif) for each
   direction. Put this triple to g[pd]
 do
 (pid; pd; dif) = smallest(g)
 appear[pid]++
 if appear[pid] = n
 h++
S=S [ pid
Read next attribute from dimension pd
   and form a new triple (pid; pd; dif). If
   end of the dimension is reached, let dif
   be 1. Put the triple to g[pd].
   while h<k
return S
End KNMatchAD
```

Algm 1. Algorithm KNMatchAD

Step 4: Reuse: adaption match: This step is for mapping the solution with the previous patient data's with the existing patients data's. This is involved in adapting the new solution as needed. If the adaption is matched it can be revised or else it again searches for the new solution.

Step 5: Revise: After mapping the data's of target patient, it tests the solution with the simulation in the real world and revises it.

Step 6: Result: retained: In this last step of CBR, disease is diagnosed and the solution is compared with the result of neural network implementation. By comparing the results the diagnosed disease perhaps gives above 97% of accuracy. The prediction is made efficient for the doctors by this methodology. Not only is the prediction made efficient but also the type of heart disease is diagnosed and the prescription of medicine is made easy to the doctors by CBR which is described in the next part of this study.

Retained: After the solution has been successfully adapted to the target patient with the ANN, the resulting experience is stored as a new case in memory with multimedia database again.

Note: In the next part of the study the diagnosed heart disease is taken as an attribute.

Prescription of medicine with RBF and CBR

Radial basis function: RBFN is an alternative to the more widely used MLP network and is less computer time

Table 3: Hypertensive heart disease

Patient No.	Patient name	Doctor's name	Medicine code
1	A	X	08, 07, 15, 19, 20, 21, 45, 47
2	B	Y	07, 15, 19, 21, 45, 47, 08, 25
3	C	Z	08, 07, 15, 19, 20, 21, 45, 47

Table 4: Congestive heart disease

Patient No.	Patient name	Doctor's name	Medicine code
1	A	X	03, 04, 09, 10, 12, 13, 16, 18, 39, 43, 44
2	B	Y	03, 04, 09, 10, 12, 13, 16, 18, 39, 43, 44
3	C	Z	03, 04, 09, 10, 12, 13, 16, 18, 39, 43, 44

Table 5: Congestive heart disease

Patient No.	Patient name	Doctor's name	Medicine code
1	A	X	04,08,11,14,17,25,28, 30,33,42,47,50
2	B	Y	04,08,11,14,17,25,28, 30,33,42,47,50
3	C	Z	04,08,11,14,17,25,28, 30,33,42,47,50

consuming for network training. RBFN consists of three layers: an input layer, a hidden (kernel) layer and an output layer. The nodes within each layer are fully connected to the previous layer. The input variables are each assigned to the nodes in the input layer and they pass directly to the hidden layer without weights. The transfer functions of the hidden nodes are RBF. An RBF is symmetrical about a given mean or center point in a multidimensional space. In the RBFN, a number of hidden nodes with RBF activation functions are connected in a feed forward parallel architecture. The parameters associated with the RBFs are optimized during the network training. These parameter values are not necessarily the same throughout the network nor are they directly related to or constrained by the actual training vectors. When the training vectors are presumed to be accurate i.e., nonstochastic and it is desirable to perform a smooth interpolation between them then linear combinations of RBFs can be found which give no error at the training vectors.

The method of fitting RBFs to data for function approximation is closely related to distance weighted regression. An interpolation RBFN is characterized by equal number of basic functions with training points. The RBF expansion for one hidden layer and a Gaussian RBF is represented by:

$$z_j(x) = \sum_i w_{ji} e^{-\frac{(\chi L-\mu N)2}{2(\sigma)\Lambda 2N}} \quad (5)$$

However, each input training point serves as a centre for the basis function. In order to ensure a smooth fit of the desired outputs, the width of each kernel has to incorporate the training points.

Preparing data for medical prescription: The data's are collected from previous old patient's records including doctor's examination about the patient's symptoms, type of the heart disease affected with the prescriptions given by the doctors. N number of patient records for different diseases with medicine can be collected in database.

There are >13 types of heart diseases like (Angina, Congenital heart disease, Congestive heart failure, coronary heart disease etc. which can affect human with different symptoms. Atleast 400 records of old patients are collected for each disease. Database like sql, oracle is used to create Tables. Individual tables are created for each disease where data's like (patient name, doctors name, hospital) with coded medicines are saved. The code for the medicines is taken only under the supervision of cardiologist.

On this data some normalization, preprocessing methods, applied for the expected output. In this paper we take only 3 diseases with records of the patients and the medicines which are coded. Different medicines are used by the doctors on all patients.

In Table 3, the data's of different old patients from different hospitals particularly for congenital heart disease are collected and recorded in the database like (patient no, patient name, doctor name, medicine prescribed) as given. So that the data's for the particular heart disease can be retrieved for analysis to prescribe the medicine for congenital heart disease

In Table 4, the data's of different old patients from different hospitals particularly for hypertensive heart disease are collected and recorded in the database like (patient no, patient name, doctor name, medicine prescribed) as given. So that the data's for the particular heart disease can be retrieved for analysis to prescribe the medicine for hypertensive heart disease.

In Table 5, the data's of different old patients from different hospitals particularly for congestive heart disease are collected and recorded in the database like (patient no, patient name, doctor name, medicine prescribed) as given. So that the data's for the particular heart disease can be retrieved for analysis to prescribe the medicine for congestive heart disease.

In Table 6, all the medicine names which are prescribed for different types of heart diseases along with their code which are prescribed by the doctors to the patients are given in the form of database which is used to know the medicine names for different heart disease by using the code as primary key. This Table contains at least 52 different medicine names which are prescribed by the doctors for different old patients.

Table 6: Medicine names

Code for medicine	Medicine name
01	Danaparoid (Orgaran)
02	Enoxaparin (Lovenox)
03	Heparin (various)
04	Aspirin CA
05	Clopidogrel (Plavix®)
06	Dipyridamole
07	Diuretics ch
08	Beta blockers CA ch
09	fosinopril (Monopril)
10	hydrochlorothiazide
11	Nitroglycerin CA
12	spironolactone (Aldactone)
13	olmesartan (Benicar)
14	Angiotensin CA
15	Inotropes ch
16	quinapril(Accupril)
17	Calcium channel blockers CA
18	diltiazem (Cardizem, others)
19	Nesiritide ch
20	Digoxin ch
21	Aldosterone antagonists

Input for the prescription of medicine: The diagnosed disease from the first scheme is taken as the input for the prescription of the medicine. This is the first step for the prescription of medicine.

Retrieve from database: When the input is given as the diagnosed diseased the data's of that particular disease retrieved with the details about the medicine coded as given in Table 6.

These records are very useful for the doctors to prescribe the medicine. Since, those medicines which are coded are given to the old patients for the heart disease.

Medicine given by the expert system like GRNN and RBF are still comparatively less. So, we implement this study to prescribe medicine with more than 400 patient's information for each disease in the database. Also with the outcome of CBR and the medicine prescribed by the RBF is compared. This analysed sample data gives higher accuracy in the medicine prescription for heart disease patients.

Experimental analysis: Analysis is done for both diagnosis and prescription of medicine. If a present patient is affected by the symptoms of heart disease this ANN and CBR is used to predict whether patient is affected by the heart disease with the training sets and the type of heart disease. With the type of the heart disease medicines are prescribed with high accuracy by analyzing the results. The following analysis shows the discussion of three diseases for medicine prescription.

Congenital heart disease:

- Medicine prescribed by RBF 08, 07, 14, 16, 18, 40, 43, 29, 30
- Medicine given by doctors from database 08, 07, 15, 19, 20, 21, 45, 47
- Medicine prescribed for the patient in the result of CBR 01, 03, 08, 07, 15, 19, 20, 21, 45, 48

Hypertensive heart disease:

- Medicine prescribed by RBF 02, 04, 09, 10, 11, 15, 17, 18, 39, 50, 23
- Medicine given by doctors from database. 03, 04, 09, 10, 12, 13, 16, 18, 39, 43, 44
- Medicine prescribed for the patient in the result of CBR 03, 04, 09, 10, 12, 13, 16, 18, 39, 43, 44, 46

Congestive heart disease:

- Medicine prescribed by RBF 04, 08, 13, 15, 18, 25, 24, 31, 36, 42, 47, 50
- Medicine given by doctors from database. 04, 08, 11, 14, 17, 25, 28, 30, 33, 42, 47, 50
- Medicine prescribed for the patient in the result of CBR 04, 08, 11, 14, 17, 25, 28, 30, 33, 42, 47, 50, 52, 34

From the analysis of prescription of medicine, RBF is not producing the appropriate result as compared with the original medicine produced by the doctors in the database and the CBR search for the different types of heart diseases. Perhaps a patient affected with more than one heart disease, the same procedure is followed to prescribe the medicine.

The analysis shows that the prescription of medicine for the heart disease patient gives 98% accuracy with the previous old patient records and CBR similarity search technique.

CONCLUSION

The main objective of this study is to evaluate the application of artificial neural network with Multilayer perceptron neural network in diagnosis of heart disease. The performance of back propagation neural network with the prediction accuracy is satisfactory but to increase the level of accuracy and to know the type of heart disease the CBR technique is integrated with ANN. So, the accuracy of 97% is adapted by using the old patient records. In this study CBR is not only used to increase the accuracy but also to predict the type of heart disease. With this output of CBR which has not only the type of heart disease but also the medicine prescribed is used to know the medicine by comparing it with the original medicine and the medicines given by the RBF (Radial Basis Function). The medicine prescribed by the above method gives 98% comparatively.

RECOMMENDATIONS

In case if any old record is not matched with the present record then expert doctor advice can be taken by certain computing methods like mobile, cloud etc.

REFERENCES

Awang, M.K. and F. Siraj, 2013. Utilization of an artificial neural network in the prediction of heart disease. Int. J. Bio-Sci. Bio-Technol., 5: 159-166.

Das, R., I. Turkoglu and A. Sengur, 2009. Effective diagnosis of heart disease through neural networks ensembles. Expert Syst. Appl., 36: 7675-7680.

Hannan, S.A., R.R. Manza and R.J. Ramteke, 2010. Generalized regression neural network and radial basis function for heart disease diagnosis. Int. J. Comput. Applic., 7: 7-13.

Heller, R.F., S. Chinn, H.D. Pedoe and G. Rose, 1984. How well can we predict coronary heart disease? Findings in the United Kingdom heart disease prevention project. Br. Med. J., Vol. 288. 10.1136/ bmj.288.6428.1409

Polat, K., S. Sahan and S. Gunes, 2007. Automatic detection of heart disease using an Artificial Immune Recognition System (AIRS) with fuzzy resource allocation mechanism and k-nn (nearest neighbour) based weighting preprocessing. Expert Syst. Appl., 32: 625-631.

Reategui, E.B., J.A. Campbell and B.F. Leao, 1997. Combining a neural network with case-based reasoning in a diagnostic system. Artif. Intell. Med., 9: 5-27.

Salahud and F. Rabbi, 2006. Statistical analysis of risk factors for cardiovascular disease in malakand division. Pak. J. Stat. Opera. Res., 2: 49-56.

Shahwan-Akl, L., 2010. Cardiovascular disease risk factors among adult Australian-Lebanese in Melbourne. Int. J. Res. Nursing, 1: 1-7.

Shouman, M., T. Turner and R. Stocker, 2012. Using data mining techniques in heart disease diagnosis and treatment. Proceedings of the Japan-Egypt Conference on Electronics, Communications and Computers, March 6-9, 2012, Alexandria, pp: 173-177.

Shouman, M., T. Turner and R. Stocker, 2013. Integrating clustering with different data mining techniques in the diagnosis of heart disease. J. Comput. Sci. Eng., 20: 11-14.

Simons, L.A., J. Simons, Y. Friedlander, J. McCallum and L. Palaniappan, 2003. Risk functions for prediction of cardiovascular disease in elderly Australians: The Dubbo study. Med. J. Aust., 178: 113-116.

Tsai, D.Y. and S. Watanabe, 1998. A method for optimization of fuzzy reasoning by genetic algorithms and its application to discrimination of myocardial heart disease. Proceedings of the IEEE Nuclear Science Symposium and Medical Imaging Conference, Volume 3, November 8-14, 1998, Toronto, Canada, pp: 1756-1761.

WHO., 2016. The Atlas of Heart Disease and Stroke. World Health Organization, Rome, Italy.