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Analysis of Heart Disease By LVQ in Neural Network

VaibhavC.Badbe (PG Student)VaishaliLondhe (Asst. Professor)GeetanjaliShirole(PG Student)
Department of Computer Engineering,Department of Computer EngineeringDepartment of Computer Engineering
Y.T.I.E.T, Karjat, Raigad ,India Y.T.I.E.T, Karjat, Raigad ,India Y.T.C.E.M, Karjat, Raigad ,India
vaibhavc.badbe@gmail.com,vaishali.londhe@tasgaonkartech.com,shirole.geeta@gmail.com

Abstract: In medical field the disease diagnosis is often made based on the knowledgeand experience of themedical practitioner. Due to this there are chances of errors, unwanted biases and also takes longer time in accurate diagnosis of disease. In case of heart disease, its diagnosis is most difficult task. It depends on the careful analysis of different clinical and pathological data of the patient by medical experts, which is complicated process. Due to advancement in machine learning, computer and information technology, the researchers and medical practitioners in large extent are interested in the development of automated system for the prediction of heart disease. ECG consists of various waveforms of electric signals of heat .To process the ECG signal we will generate a multi-layered learning algorithm using a Learning vector Quantization (LVQ) neural network with generalized delta rules under supervised learning. The neural network in this system accepts 13 clinical features as input and predicts that there is a presence or absence of heart disease in the patient, along with different performance measures.

Keywords: *Heart disease, Learning Vector Quantization (LVQ), electrocardiogram (ECG), myocardial ischemia, myocardial infarction.*

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I. INTRODUCTION

The heart is the organ that pumps blood over veins to various body parts, with sufficient extent of oxygen and other key dietary segments that are required. The life of any living being is absolutely reliant of the best possible working of the heart and if there is some issue in the pumping activity of the heart, the fundamental organs of the body like the mind and kidneys are unfavourably influenced. On the off chance that the working of the heart stops then the passing of the individual happens inside couple of minutes.

The term coronary illness implies diverse issues that influence the typical working of circulatory framework, which comprises of heart and veins. There are diverse classifications of heart illnesses like cardiovascular malady in which the heart and veins are influenced and as a consequence of which the blood is not pumped and flowed legitimately all through the body parts. In coronary illness the heart does not get adequate blood that it requires in view of cholesterol and fat that is saved inside the mass of the veins that supply the blood to heart. In myocardial areas of dead tissue which is otherwise called a heart assaults in which the way in the coronary conduit is hindered because of the coagulating of blood on the mass of the corridor that supply the blood to the heart. In angina mid-section torment happens because of the supply of blood that is deficient to the heart as a consequence of which it doesn't work appropriately. There are likewise different types of coronary illness that incorporate coronary conduit malady, valvular coronary illness, stroke, hypertension, and so on.

In this day and age, vast number of populace is experiencing diverse sorts of heart ailments and the tally of patients experiencing and biting the dust these infections is expanding step by step. So there is need of exact and early discovery of coronary illness with appropriate and satisfactory treatment which can spare the life of numerous patients. However, tragically, because of the confused procedures and diverse side effects and obsessive tests the right conclusion of heart infections is a troublesome assignment and causes delay in the correct treatment. Subsequently, there is a need to build up the forecast frameworks for coronary illness which can help the restorative specialists in the early and exact analysis of coronary illness and the patient is given fitting and sufficient treatment at legitimate stage then the life of vast number of individuals can be spared furthermore the expense of the treatment can be lessened essentially. So there is a need to build up a forecast framework to recognize the nearness or nonappearance of coronary illness in the patient with higher precision.

In our framework the arrangement depends on Artificial Neural Network (ANN). ANN is only a data handling framework that procedure the data in the comparative way as the organic sensory system forms. Like human they learn by illustration and can be designed for particular application, for example, design acknowledgment or information arrangement through a procedure of preparing and learning. In this arrangement framework we have utilized manufactured neural system since they have capacity to get importance from confounded or uncertain information which could be utilized to concentrate extraordinary examples or highlights and distinguish patterns that are more perplexing to be seen by either people or other PC procedures and strategies. A neural system in the wake of preparing could be considered as a specialist specifically class of data that has been given to it for dissect. Because of this capacity the fake neural systems are being connected to expansive number of certifiable issues. As the analysis of coronary illness is exceptionally mind boggling and troublesome procedure, the therapeutic professionals and scientists are enormously intrigued by building up the mechanized framework for finding of coronary illness utilizing simulated neural system.

II.EXISTING WORK

Hypertrophic cardiomyopathy (HCM) is a cardiovascular ailment where the heart muscle is incompletely thickened and blood stream is (conceivably lethally) deterred. A test taking into account electrocardiograms (ECG) that record the heart electrical movement can help in early recognition of HCM patients. This paper displays a cardiovascular-understanding classifier we created to recognize HCM

patients utilizing standard 10-second, 12-lead ECG signals. Patients are named having HCM if the lion's share of their recorded heartbeats are perceived as normal for HCM. In this way, the classifier's hidden assignment is to perceive singular heartbeats portioned from 12-lead ECG signals as HCM thumps, where heartbeats from non-HCM cardiovascular patients are utilized as controls. [1]

A fluffy tenet based choice emotionally supportive network (DSS) is introduced for the determination of decision support system (CAD). The framework is naturally created from an underlying commented on dataset, utilizing a four stage technique; 1.induction of a choice tree from the information; 2.extraction of an arrangement of principles from the choice tree, in disjunctive typical structure and detailing of a fresh model; 3.transformation of the fresh arrangement of standards into a fluffy model and 4.optimization of the parameters of the fluffy model.[2]

The best test confronted amid the procedure of analysis of cardiovascular maladies is the exact investigations of the Electrocardiogram (ECG). Numerous scrutinizes are being done to arrange and break down the ECG flags naturally. A novel technique for the Auto examination of the ECG signals utilizing MATLAB is proposed and executed. In this strategy, the crude ECG information got from the patient experiences a procedure of Wavelet Packet Decomposition (WPD) trailed by Feature extraction. The characterization is further done utilizing Artificial Neural Network (ANN). This strategy, succeeding in separating the Abnormal ECG signals from the Normal signs, is turned out to be a novel technique for Auto investigation of ECG signs. [3]

In this paper a forecast framework for coronary illness utilizing multilayer perceptron neural system. The neural system in this framework acknowledges 13 clinical components as information and it is prepared utilizing back-engendering calculation to anticipate that there is a nearness or nonappearance of coronary illness in the patient with most noteworthy exactness similar to different frameworks. The precision subsequently acquired with this framework demonstrates that it is preferable and productive over different frameworks. [4]

As colossal measure of information is made in therapeutic affiliations (recuperating workplaces, supportive concentrates) yet this information is not honest to goodness utilized. The social protection system is "data rich" however "learning poor ". There is a nonattendance of powerful examination techniques to find affiliations and case in restorative administrations data. Data mining procedures can help as cure in this circumstance. Along these lines, particular data mining systems can be utilized. The paper hopes to give bits of knowledge about various frameworks Of data reflection by using data mining procedures that are being used as a piece of today's investigation for desire of coronary sickness. [5]

The paper addresses one of the testing issues in human services benefits particularly to develop nations by proposing a novel component extraction procedure appropriate for ECG convenient gadgets. The technique utilized ECG signals information from MIT-BIH database and diverse channels were intended to decrease undesirable sign like pattern meander and electrical cable impedance. QRS complex was identified utilizing surely understood and worthy Pan Tompkins calculation, R-R interims highlights without applying any operation or change are utilized as benchmark. DWT was utilized to break down R-R interims and give a period recurrence representation of the sign. The factual parameters of DWT coefficients were ascertained and utilized as crossover highlight for preparing and testing utilizing neural system classifier .[6]

III. PROPOSED SYSTEM

A. Neural Network:

A artificial neural network (ANN), more often than not called "neural system" (NN), is a numerical model or computational model that is motivated by the structure and/or practical parts of organic neural systems. It comprises of an interconnected gathering of manufactured neurons and procedures data utilizing a connectionist way to deal with calculation. As a rule an ANN is a versatile framework that progressions its structure in view of outer or inward data that moves through the system amid the learning stage. Current neural systems are non-straight measurable information demonstrating apparatuses. They are generally used to model complex connections amongst inputs and yields or to discover designs in information.

A neural system is the neuron .This unit is in charge of the summation of all weighted inputs which are changed in a progression of layers. The main layer in the neural system is the information layer which comprises of comparing information values. The second layer in the neural system is known as the shrouded layer and is typically completely associated with the info layer. The third layer is the yield layer. A general neural system model is outlined in figure.

The qualities X0, X1, X2... Xn speak to the information vectors. These are the variables which are characterized as either downright or consistent and are utilized to anticipate the last result. The quality Yj speaks to the last result for the jth perception. Known estimations of Yj are utilized to characterize the neural system, and to decide the viability of the model.

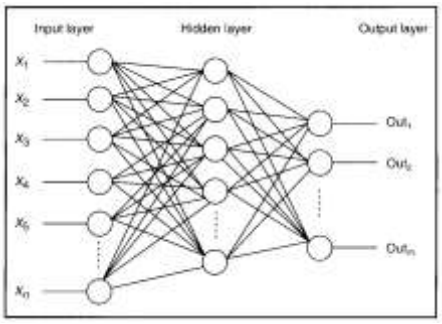


Fig.1 General Neural Network Model.

The weights Wil... Wij are qualities appointed to the vectors X0, X1, X2... Xn , to decide in a versatile way just which of the components of the vector Xj ought to be more vigorously underlined than others in anticipating the result Yj.

There are two stages in neural processing: learning and review. The learning stage (registered on a preparation set) is the stage amid which the weights of the system are conformed to yield the fancied yield. The weights are over

and again balanced until the forecast blunder is at the very least or until it is resolved that the system has sufficiently displayed the information in the choice space. The weights are then settled and the review stage starts. Amid the review stage, the system is tried for its capacity to sum up to the expectation issue on information not seen beforehand. Expectation mistake can then be figured to decide the capacity of the system to sum up to new information. The standards are contained in a 'discovery' so that nobody mathematical statement rises characterizing the weights. Extra information must be contribution to the neural system procedure to decide the precision of expectation.

Neural Networks have two principle capacities: Pattern classifiers and as non-direct versatile channels. This is known as the preparation stage. A manufactured neural system is produced with an orderly regulated method which improves a foundation normally known as the learning principle. The info/yield preparing information is key for these systems as it passes on the data which is important to find the ideal working point. Furthermore, a non-direct nature makes neural system handling components an exceptionally adaptable framework. Fundamentally, a manufactured neural system is a framework. A framework is a structure that gets information, process the information, and gives a yield. Once information is introduced to the neural system, and a relating craved or target reaction is set at the yield, a blunder is made from the distinction out of the sought reaction and the genuine framework yield. The blunder data is encouraged back to the framework which makes all conformity to their parameters in a deliberate manner (normally known as the learning principle). This procedure is rehashed until the sought yield is worthy. Notice that the execution pivots intensely on the information. There are diverse classes of system models i.e. single layer food forward system. Multi-layer nourish forward system, repetitive system.

B. Types of Neural Network Learning Techniques:

There are three major learning paradigms, each corresponding to a particular abstract learning task. These are:-

Supervised learning: It is characterized by the presence of the Supervisor; Supervised Learning is always followed by a test. If the test score is above the threshold then Learning has to be repeated. This process continues until the test score is above the desired threshold.

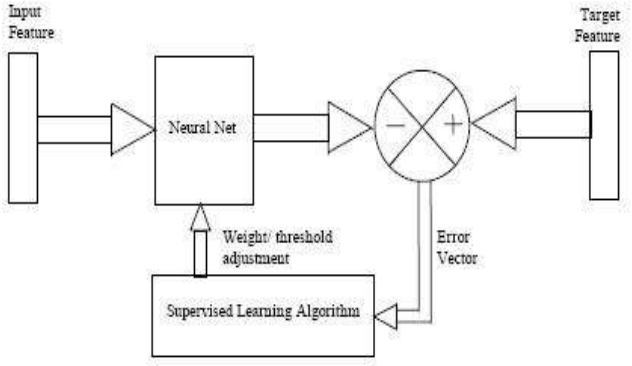
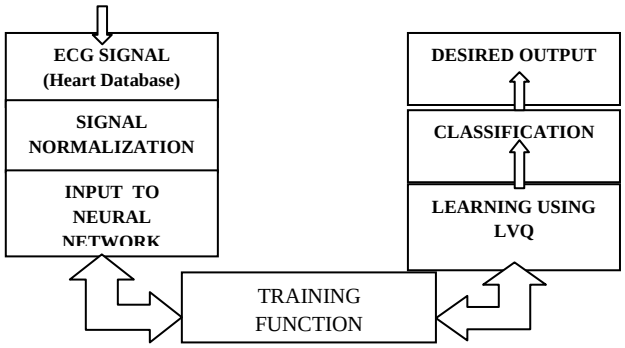


Fig.2 Supervised learning.

Unsupervised learning: Unsupervised learning happen by the own experiences of the system. There is no Supervisor present during the Learning. Unsupervised learning or Self-organization in which an (output) unit is trained to respond to clusters of pattern within the input. In this paradigm the system is supposed to discover statistically salient features of the input population. Unlike the supervised learning paradigm, there is no a priori set of categories into which the patterns are to be classified; rather the system must develop its own representation of the input simultaneously.

Reinforcement Learning This type of learning may be considered as an intermediate form of the above two types of learning. Here the learning machine does some action on the environment and gets a feedback response from the environment. The learning system grades its action good (rewarding) or bad (punishable) based on the environmental response and accordingly adjusts its parameters. Generally, parameter adjustment is continued until an equilibrium state occurs, following which there will be no more changes in its parameters. The self-organizing neural learning may be categorized under this type of learning.

C. Block Diagram of Proposed System :



In this system for heart disease classification, learning vector quantization (LVQ) neural network algorithm is used. The main purpose of using LVQ is that it creates prototypes that are easy to interpret for experts in the respective application domain. LVQ network is a nearest neighbour pattern classifier based on competitive learning. It is generally applicable in problems of nonlinear separation and used for data classification in large extent. The system consists of two steps, in the first step 13 clinical attributes are accepted as input and then the training of the network is done with training data by LVQ algorithm.

A. Learning vector quantization (LVQ) neural network:

Learning vector Quantization is a special case of competitive network, which uses supervised learning methodology. It is the well-known algorithm that deals with the process of classifying the patterns or selecting prototypes. LVQ network is a nearest neighbour pattern classifier based on competitive learning. It is generally applicable in problems of non-linear separation and used for data classification in large extent.

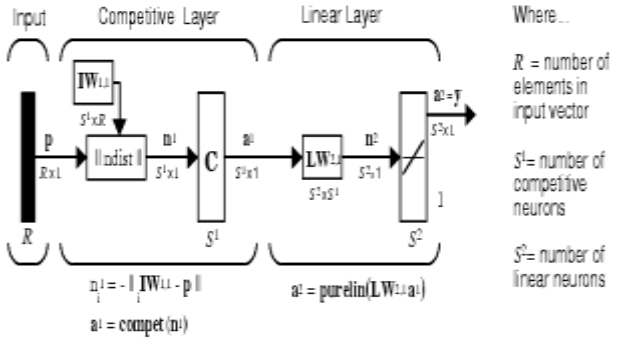


Fig.4 LVQ Network Architecture.

The architecture of LVQ is similar to the Kohonenself-organizing map, but the main difference is that in LVQ, the topological structure at the output unit is not considered. The LVQ network architecture is shown in figure 2.Where R is the number of elements in input vector, S^1 is the number of competitive neurons and S^2 is the number of linear neurons. As shown in figure 2, LVQ network has a competitive layer and a linear layer. When the input vector is given to thecompetitive layer it firstly learns to classify that input vectors in to classes in the same way as the competitive layers of cluster with self-organizing map neural network. The linear layer then transforms classes of competitive layer into target classifications that is defined by the user. The classes learned by the competitive layer are referred to as subclasses and the classes of the linear layer as target classes. The layers in LVQ have one neuron per class that is competitive and linear layers have one neuron for each class. Thus, there can be total S^1 subclasses learn by competitive layer and S^2 target classes that are formed by linear layer by combining the S^1 subclasses from competitive layer, such that S^1 is always larger than S^2.

The LVQ network is made up of two layers that are a competitive layer and a linear layer. In the competitive layer, each neuron is assigned to a particular class. The number of classes in the competitive layer is determined by the number of neurons in hidden layer. There may be number of different neurons in the competitive layer that can be assigned to the same class. Each of those classes is then assigned to one of the neuron in the linear layer. The number of neurons in thecompetitive layer is always greater or equal to the number of neurons in the linear layer. In the competitive layer, the neuron learns a prototype vector which allows it to classify a region of the input space. Euclidean distance is used to measure the similarity between the input vector and any of the weight vectors. Since some of these classes may be identical, they are really subclasses. The second layer (the linear layer) of the LVQ network is then used to combine subclasses that are formed by competitive layer into a single class. This is done by using the weight matrix. This process is known as "training" of neural network.

B.Training Algorithm:-

The algorithm for the LVQ neural network is to find the output unit that has a matching pattern with the input vector. At the end of the process, if x and w belong to the same class, weight are moved toward the new input vector and if they belong to a different class, the weight are moved away from input vector. In this case also similar to Kohonenself-organizing feature map, the winner unit is identified. The winner unit index is compared to the target, and based upon its comparison result; the weight updating is performed as shown in the algorithm given below. The iteration is further continued by reducing the learning rate.

The algorithm is as follows:

Step 1: Initialize weights (reference) vectors.
Initialize learning rate.

Step 2: While stopping is false, do step 3-7

Step 3: For each training input vector x, do step 4-5

Step 4: Compute j using squared Euclidean distance
$D(j) = \sum (x_i - w_{ij})^2$
Find j when D (j) is minimum

Step 5: Update w_j as follows:
If t= c_j then
$w_{j(new)} = w_{j(old)} + \alpha[x\text{-}w_{j(old)}]$
If $t \neq c_J$, then
$w_{j(new)} = w_{j(old)} - \alpha[x\text{-}w_{j(old)}]$

Step 6: Reduce the learning rate.

Step 7: Test for stopping condition.

The condition may be fixed number of iteration or the learning rate reaching a sufficiently small value.In this prediction system the Cleveland heart disease database is used to fed the input to neural network. The network is having three layers. The learning vector quantization algorithm is trained with random order incremental training. In the input layer of the network there are 13 neurons that accept the 13 values of clinical information from the heart disease database. The hidden layer neurons can be varied in order to reduce error and increase accuracy. The output layer consists of single neuron that indicates whether the heart disease is present or absent

V. EXPERIMENTAL RESULTS

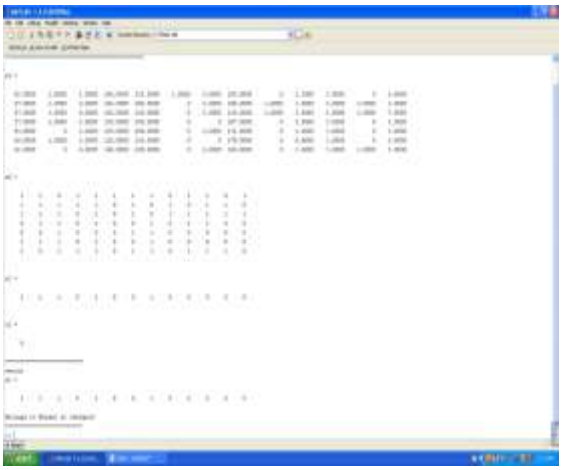
A. Data Source

The performance of the system is evaluated on Cleveland heart disease database that was taken from dataset repository of UCI. This database consists of 303 records with each having 13 clinical attributes that include age, sex, type of chest pain, resting blood pressure, cholesterol, fasting blood sugar, resting ECG, maximum heart rate, exercise induced angina,

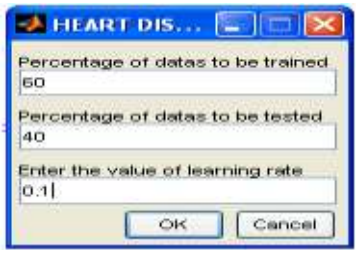
old peak, slope, number of vessels coloured and thatrespectively. In this database out of 303 records 164 belong tohealthy category and 139 belong to heart disease [14].

B. Results:

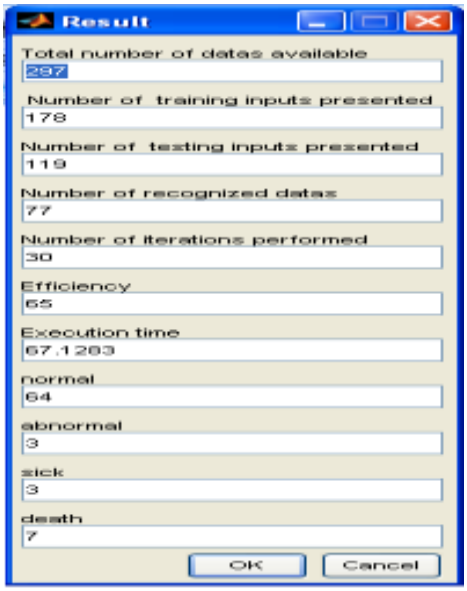
NEURAL NETWORK PROCESS:



Training Data:



Classification:



VI. CONCLUSION

The efficient system for prediction of heart diseases is developed. The system accepts the 13 clinical features asinput and the training of network is done by using Learning Vector Quantization algorithm. It gives the presence or absence of heart disease. The system also computes different parameters like Efficiency, Number of Epoch, and Execution time. The prediction system for heart disease can be enhanced to incorporate other neural network algorithms so that the accuracy can again be increased and it can be deployed in large number of health care centres.

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