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ANN for Diagnosing Hepatitis Virus

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Abstract: *This paper presents an artificial neural network based approach for the diagnosis of hepatitis virus. A number of factors that may possibly influence the performance of patients were outlined. Such factors as age, sex, Steroid, Antivirals, Fatigue, Malaise, Anorexia, Liver Big, Liver Firm Splean Palpable, Spiders, Ascites, Varices, Bilirubin, Alk Phosphate, SGOT, Albumin, Protine and Histology, were then used as input variables for the ANN model . Test data evaluation shows that the ANN model is able to correctly predict the diagnosis of more than 93% of prospective Patients.*

Keywords: Artificial Neural Networks, Hepatitis, Feedforward, Generalized Regression, Self Organizing Maps

1. INTRODUCTION

One of the most important features in medicine is the diagnosis of the disease. The diagnosis is defined as the analysis of the physiological or biochemical cause of the disease [1]. It is a complex task and involves a certain level of expertise on the part of the doctor. A sophisticated system is needed to help doctors diagnose the disease accurately and efficiently. The use of technology, especially artificial intelligence (Al), can reduce cost, time, human experience and misdiagnosis [2].

Artificial Neural Networks (ANN) is a type of artificial intelligence that has been widely applied to solve medical problems. It has been used in many applications such as diagnosis, prediction, image analysis, etc. [2]. The ANNs are systems made up of neurons that work in a similar way to the brain. Hepatitis is one of the most deadly diseases. Early detection increases the chances of multiple healing. Hepatitis causes inflammation and destruction of liver cells (liver cells).

Hepatitis can be caused by viruses, bacteria, medicines and others. The disease can be classified as acute or chronic. Acute hepatitis is a rapid, severe and painful onset of the disease. Acute symptoms are more painful for patients, but they are of limited duration and rarely last more than a month or two. Typically, there is only minimal damage to liver cells and little evidence of immune system activity. Chronic hepatitis is a hepatitis that lasts for more than six months. [3] Normally, hepatocellular cells are found in cells that are composed of lymphocytes, plasma cells and sometimes lymphatic follicles. There are five different types of Hepatitis A, B, C, D and E viruses.

Hepatitis A and E are of acute type whereas Hepatitis B, C and D are of chronic type. The chronic hepatitis leads to cirrhosis which causes destruction of liver parenchymal cells.
The purpose of this paper is to use the dataset for the diagnosis of hepatitis using an Artificial Neural Network (ANN). A performance comparison has also been shown between the networks we used and the results were also compared with the previous studies that used the same dataset for the diagnosis and classification of hepatitis.

A practical approach to this type of problem is to apply common regression analysis in which historical data are best fitted to some function. The result is an equation in which each of the inputs xj is multiplied by a weight wj ; the sum of all such products and a constant θ, then gives an estimate of the output $y = \Sigma wj xj + \theta$, where j=0..n[40-50].

The problem here is the complexity of selecting a proper function competent of capturing all forms of data associations as well as automatically adjusts output in case of further information, because the performance of a candidate is controlled by a number of factors, and this control/association is not going to be any straightforward well-known regression model.

An artificial neural network, which emulates the human brain in solving a problem, is a more common approach that can tackle this kind of problem. Thus, the attempt to put up an adaptive system such as Artificial Neural Network to diagnosis of hepatitis virus based on the consequence of these factors[51-62].

The aims of this study are:
- to identify some suitable factors that affect a diagnosis of hepatitis virus
- to convert these factors into forms appropriate for an adaptive system coding, and

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- to model an Artificial Neural Network that can be used to predict a diagnosis of hepatitis virus based on some predetermined data for a given Patient .
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2. Literature Review

Nowadays, ANNs have significantly been used in the field of medicine. They have been applied in the area of pathology, radiology, cardiology, oncology [1]. The ANN have also been used for the diagnosis and classification of various diseases.

Bascil et al. used both the Multilayer Perceptron (MLP) with Levenberg Marquardt training algorithm and Probabilistic Neural Network (PNN) for the diagnosis of hepatitis and used the UCI dataset for this purpose [7].

Jilani et al. used MLP with backpropagation algorithm for the classification of hepatitis C virus using the dataset from UCI machine learning repository [8]. Uttreshwar et al. used both the GRNN and SOM for the diagnosis of hepatitis B using the same UCI dataset [1].

Liang et al. used the ANN for the visualization and classification of Emphysema [9]. ANN is also used for the Classification of Impulse Oscillometric Patterns of Lung Function in Asthmatic Children [10].

Sana Ansari et al. used three types of networks out of which two belong to the supervised category; the Feedforward Backpropagation Neural Network (FFNN) and Generalized Regression Neural Network (GRNN) and one belongs to the unsupervised type; Self Organizing Map (SOM) .

3. The Artificial Neural Networks

Artificial neural networks (ANN) or connectionist systems are computing systems indecisively inspired by the biological neural networks that establish animal brains.[4] Such systems "learn" to perform tasks by seeing examples, commonly without being programmed with any task-specific rubrics. They automatically produce identifying features from the learning material that they process [35-39].

An ANN is grounded on a gathering of connected components or nodes called artificial neurons which roughly model the neurons in a biological brain. Each connection, such as the synapses in a biological brain, can convey a signal from one artificial neuron to an alternative one. An artificial neuron that collects a signal can process it and then signal extra artificial neurons linked to it.

In common ANN applications, the signal at a connection among artificial neurons are a actual number, and the result of each artificial neuron is figured by some non-linear function of the totality of its inputs. The connections among artificial neurons are named 'edges'. Artificial neurons and edges naturally have a weight that fine-tunes as learning continues. The weight upsurges or decreases the forte of the signal at a connection. Artificial neurons may have a threshold such that the signal is only directed if the collective signal crosses that threshold. Naturally, artificial neurons are combined into layers. Different layers might do different types of transformations on their inputs. Signals portable from the first layer (the input layer), to the last layer (the output layer), perhaps after crossing the layers manifold times [10-12].

The original aim of the ANN method was to resolve problems in the same way that a human brain would. But, over time, courtesy enthused to performing precise tasks, leading to deviancies from biology. Artificial neural networks have been used on a diversity of tasks, with computer vision, speech recognition, machine translation, social network filtering, playing board and video games and medical analysis [13-15].

ANN learning can be either supervised or unsupervised. Supervised training is done by giving the neural network a set of data sample along with the expected outputs from each of these samples. Supervised training is the most common form of neural network training. As supervised training proceeds the neural network is taken through several iterations, or epochs, until the actual output of the neural network matches the anticipated output, with a reasonably small error. Each epoch is one pass through the training samples. Unsupervised training is similar to supervised training except that no anticipated outputs are provided. Unsupervised training usually occurs when the neural network is to classify the inputs into several groups. The training progresses through many epochs, just as in supervised training. As training progresses the classification groups are “discovered” by the neural network [16-20].

Training is the process by which these connection weights are assigned. Most training algorithms begin by assigning random numbers to the weight matrix. Then the validity of the neural network is examined. Next the weights are adjusted based on how valid the neural network performed. This process is repeated until the validation error is within an acceptable limit [5, 21].

Validation of the system is done once a neural network has been trained and it must be evaluated to see if it is ready for actual use. This final step is important so that it can be determined if additional training is required. To correctly validate a neural network validation data must be set aside that is completely separate from the training data [6, 22].

About 70% of the total sample data was used for network training in this paper. About 30% of the total sample data served as validation of the system [23-34].

4. Methodology

Through the research and diagnosis of a number of patients with the hepatitis virus, a number of factors have been identified that are considered to assist in the diagnosis of this disease. These factors were carefully studied and synchronized with an appropriate number suitable for coding the computer within the modeling environment ANN. These factors were classified as input variables. Output variables reflect the likelihood of a patient's survive or death from the hepatitis virus.

4.1. The Input Variables

1. Patient's Age
2. Patient's Gender
3. Steriod
4. Antivirals
5. Fatigue
6. Malaise
7. Anorexia
8. Liver Big
9. Liver Firm
10. Spleen Palpable
11. Spiders
12. Ascities
13. Varices
14. Bilirubin
15. Alkaline Phosphatase
16. SGOT
17. Albumin
18. Prothrombin Time
19. Histology

Table 1. Input Data Transformation

Input Attributes					
S. No	**Attributes**	**Values**	**S. No**	**Attributes**	**Values**
1	Age	10-80 Years	11	Spiders	No, Yes
2	Gender	Male, Female	12	Ascities	No, Yes
3	Steriod	No, Yes	13	Varices	No, Yes
4	Antivirals	No, Yes	14	Bilirubin	0.39 - 4.00
5	Fatigue	No, Yes	15	Alkaline Phosphatase	33, 80 - 250
6	Malaise	No, Yes	16	SGOT	13,100 - 500
7	Anorexia	No, Yes	17	Albumin	2.1-6.0
8	Liver Big	No, Yes	18	Prothrombin Time	10 - 90
9	Liver Firm	No, Yes	19	Histology	No, Yes
10	Spleen Palpable	No, Yes			

4.2. The Output Variable

The output variable represents the diagnosis of hepatitis by knowing the probability of survive or death of this patient.

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Table 2. Output Data Transformation

Output Class		
S. No	**Attributes**	**Values**
1	Class	Die, Live

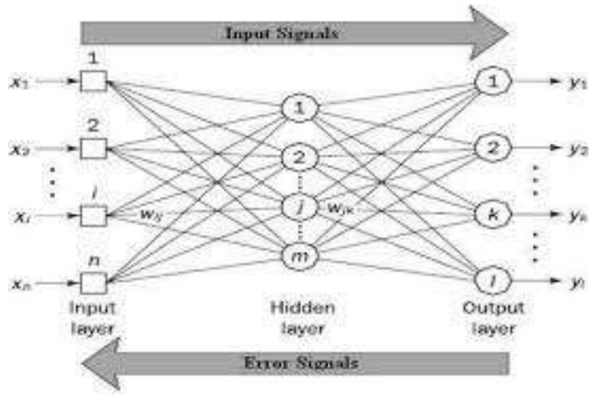

Figure 1: Network Architecture

5. Design of the Neural Networks

5.1. Network Architecture

The network is a multilayer perceptron neural network using the linear sigmoid activation function as seen in Figure 1.

As stated earlier, the purpose of this experiment was to diagnose patients with hepatitis. We used feed forward Backpropagation, which provides the facility to implement and test the neural network and its learning algorithm. Our neural network is a feed-forward network, with Single input layer (19 inputs), a hidden layer (6 inputs) and a single Output layer (4 outputs).

A total of 216 patients records were used in the analysis. About 70% of the total data (*i.e.* 152 patients) were used as the training set, and 30% (*i.e.* 64 patients) used for cross validation.

After the training and cross validation, the network was tested with the test data set and the following results were obtained. This involves given the input variable data to the network without the output variable results. The output from the network is then compared with the actual variable data.

The neural network was able to predict accurately 32 out of 32 for live data, and 31out of 32 of Die data which represents patients with hepatitis used to test the Network's topology. This indicates an overall accuracy of 98.44% for the Artificial Neural network's which a good performance (See Figure 4).

Figure 2: Relative importance of the Input variables

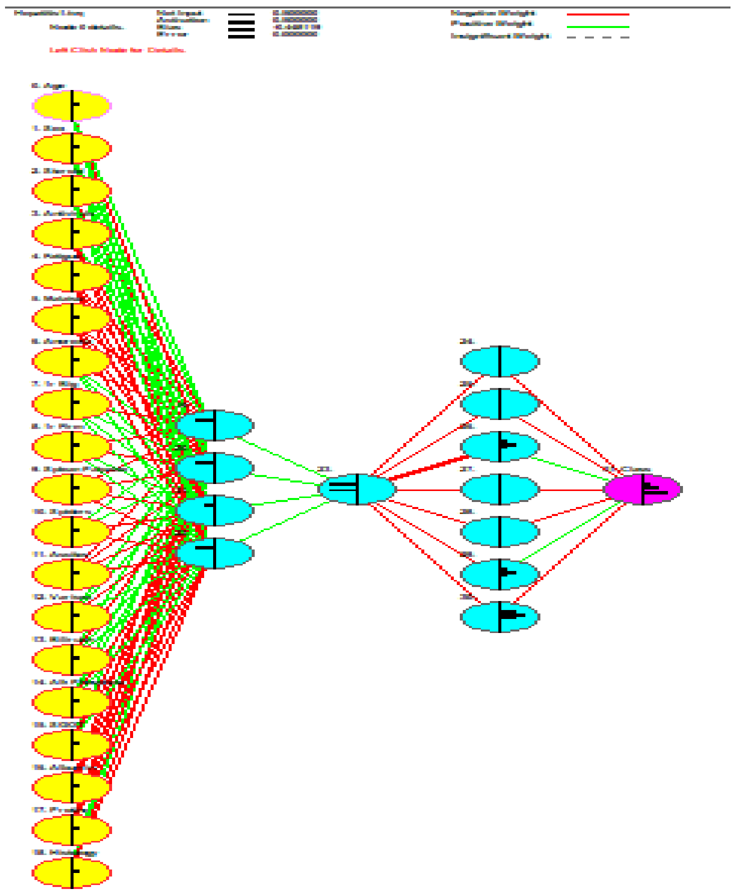

Figure 3: Final ANN Architecture

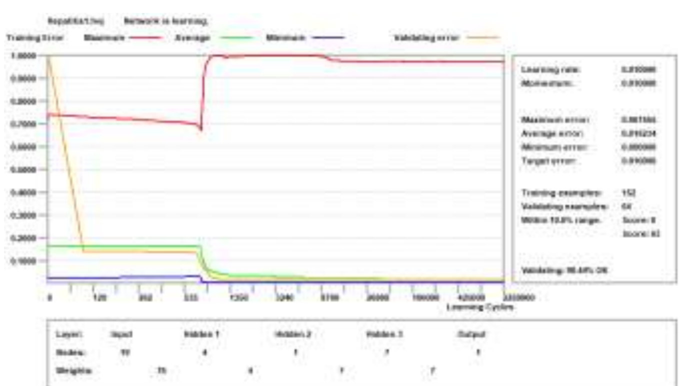

Figure 4: Training and testing of the ANN model

7. Conclusion

An artificial Neural Network model for diagnose patients with hepatitis was presented. The model used feed forward backpropagation algorithm for training. The factors for the model were obtained from patient records. The model was tested and the overall result was 98.44%. This study showed the potential of the artificial neural network for diagnoses patients with hepatitis by knowing the probability of survive or death of this patient.

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