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design the new system using artificial neural networks in detection of fatty liver disease

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Abstract

The aim of this study is to design the new system using artificial neural networks in detection of fatty liver disease. Nowadays, the most application of neural networks in medicine is in clinical and diagnostic systems. The techniques are different from the analysis of medical data and have different statistical methods such as linear and logistic regression in the field of medical data analysis. In this study, we used medical data including parameters: Age, Gender, Phosphatase, Albumin, Globumin, and Albumin to Glomobin ratio and… Two patient and healthy samples were used to determine the predictive power of characteristics, the correlation and distribution of categorical variables used in two groups of patients were first analyzed by a multidimensional test ($p < 0.05$). According to available information from patients with fatty liver and that these patients are divided into two general categories, we compared the input and output relationships of this information using the neural network, and So, according to the model obtained in this project, it is possible to predict the newly arrived situation with a very high accuracy. Artificial Neural Networks are one of the computational methods in artificial intelligence of new computing systems and methods. The results show that the neural network model has a low error and high explanatory power and therefore has good predictive power. Now you can check the status of your liver fat by taking information in 3 questions from each person you visit.

Keywords: Artificial neural network, fatty liver, medical technology

Introduction

One of the most common diseases and causes of death in the world today is liv The use of artificial neural networks to create predictive models is very helpful in identifying people at risk to reduce the complications of the disease. In this paper, we intend to use a study of the general model of the diagnosis of fatty liver disease

The main purpose:

The main purpose of this study is to design and present a new method for diagnosis of Fatty Liver Disease using artificial neural networks in a way that is collected using various data. It is considered that the result of diagnosis and traditional diagnostic methods or the new method used by designing neural networks it can be faster, more precise and more complete.

Sub-goals:

1- The Relationship between Application of Artificial Neural Networks and Reducing Duration of Fetal Liver Disease
2- The Relationship between Application of Artificial Neural Networks and Reducing Unnecessary Sampling for Detection of Fatty Liver Disease
3- The Relationship between Artificial Neural Network Application and Diagnosis of Fatty Liver Disease

Figure 1 shows the general scheme of fatty liver disease diagnostic systems. In accordance with this figure, at first the data set is entered and the nominal data is converted to numerical data of the normalization operation so the data set can be used. After normalizing operations to create an optimal model with high accuracy in detection and low detection rate, using the selection and reduction algorithms to select the most suitable features for modeling using classification techniques. After the operation, the selection of the feature of the modeling operation is performed on the reduced data set and the optimality of the results of the model is evaluated. The feature selection operation is performed using the algorithm to select and reduce the feature until it reaches the optimal answer.

The output of this stage is a set of features that will give you the best response from modeling. Then, the final model is made using the classification algorithm and used to evaluate the test data and the evaluation criteria are extracted in the last step to be compared with the results of the same research.

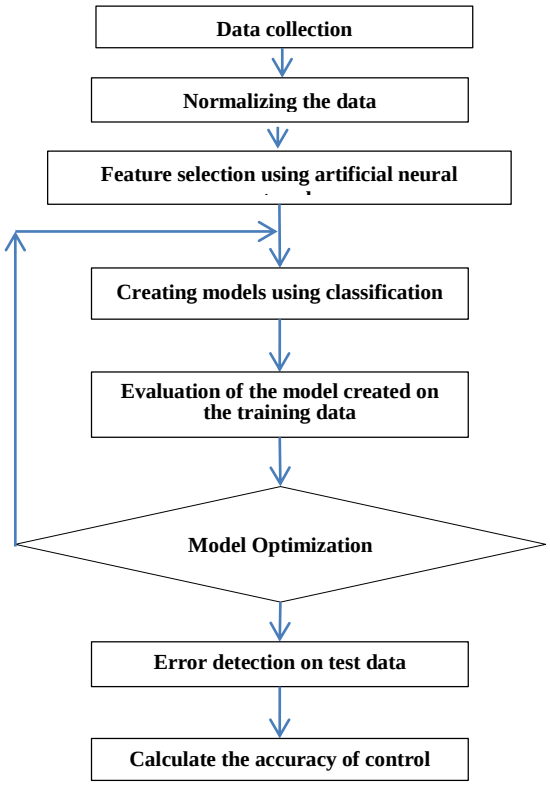


Figure 1: Generalized scheme of artificial neural network algorithm

Figure 2 shows the algorithm of the proposed method. According to this algorithm, the initial data is transformed into a data set that can be used in the artificial neural network under normalization operations. This conversion is done to convert the nominal data to numerical data. After dividing the dataset into two parts of the training and

testing, the feature selection operation is performed using the colonial competition algorithm. Then, the modeling operation is performed using a classification on the training data and a modeling error is obtained. If the modeling error is not close to optimum mode, the optimal selection and modeling procedure is performed again. Finally, the model created on the test data is evaluated and the modeling criteria are obtained.

In this study, software was developed to diagnose fatty liver disease and after its technical and practical evaluation, the software was installed and used in computers of the emergency department of hospitals affiliated to Shahid Beheshti University of Tehran. This research was conducted as part of the applied research.

In the initial stage of the research, it was necessary to obtain comprehensive information about the nature of the disease in order to better understand it. For this purpose, library studies were conducted on this subject. According to general surgery guidelines such as the Schwartz's principles of surgery Book, Surgical Emergencies in Clinical Practice Book, Maingot's Abdominal Operations and …, the Clinical and Hospital Lists in Hospital Libraries, Complete Studies on Fatty Liver Disease, Symptoms, Clinical manifestations and Features that are involved in the diagnosis of this disease.

Features involved in the diagnosis of fatty liver

Over the years, surgical experts have identified various criteria for diagnosing fatty liver disease. Using the registered features, several scoring systems have been developed to help diagnose the disease. These features include symptoms and patient complaints, clinical examinations and laboratory tests that are used in a variety of scoring systems with little difference. For example, the low levels of leukocytosis, which vary in different scoring systems. These systems include the Alvarado scoring system, the Ripasa scoring system, and the inflammatory scoring system for Fatty Liver Disease. Scoring systems are listed in the table below:

Table 1 Alvarado Scoring System

Alvarado Score		
Scoring Elements	Description	Score
Migratory right iliac fossa pain		1
Anorexia		1
Nausea or vomiting		1
Tenderness: right iliac fossa		2
Rebound tenderness right iliac fossa		1
Fever	≥36.3°C	1

Leukocytosis	≥10 × 109 cells/L	2
Shift to the left of neutrophils		1

Alvarado Scoring System

Score below 3: Low chances of having a fatty liver

Score Between 4 and 6: Use Imaging Methods to Help Identify

Top score of 7: Most likely fatty liver

Table 2: Fatty Liver Inflammatory Response Scoring System

Appendicitis Inflammatory Response Score		
Scoring Elements	Description	Score
Vomiting		1
Pain in the right inferior fossa		1
Rebound tenderness or muscular defense	Light Medium Strong	1 2 3
Body temperature	≥38.5°C	1
Polymorphonuclear leukocytes	70%–84% ≥85%	1 2
White blood cell count	10.0–14.9 × 109 cells/L ≥15.0 × 109 cells/L	1 2
Creactive protein concentration	10–49 g/L ≥50 g/L	1 2

The fatty liver inflammatory reaction scoring system

Score between 0 and 4: low probability, patient tracking and clearance

A score between 9 to12: high possibility of fatty liver disease

Score Between 5 to 8: Median Opportunity Group, Active Follow-up with Diagnostic Laparoscopy

Table 3 Ripasa Scoring System

RIPASA scoring system			
Scoring Elements	Description	Score	Probability
sex	Male Female	1 0.5	0.90 0.75
Age	< 39.9 yrs > 40 yrs	1 0.5	0.83 0.85
Phosphatase		0.5	0.70
Album		0.5	0.83
Anorexia		1	0.90
Nausea & Vomiting		1	0.90
Duration of symptoms	< 48 hrs > 48 hrs	1 0.5	0.86 0.79
Globomin		1	0.84
Albumin to Glomobin ratio		2	0.92
Rebound tenderness		1	0.88
Rovsing's Sign		2	0.91
Fever		1	0.94
Raised white cell count		1	0.86
Negative urinalysis		1	0.87
Foreign national registration identity card		1	0.96

The features used in this study include all the features of these three scoring systems. Those with leukocytosis with different thresholds in the scoring systems were put in all cases for a survey to determine the chosen threshold for these cases. In this study, a sample of data series including age, sex, phosphatase, albumin, globulin, albumin to glomerulus ratio, etc., is related to two samples of patients and healthy, and the information series available at http://www.filemap.sellfile.ir has been downloaded. These data were verified with the co-operation of specialized physicians

and surgical and emergency departments of affiliated hospitals of Shahid Beheshti University of Medical Sciences, and part of their patients' information was also used in this study. In this study, 17 specialized physicians including 5 internal surgeons and 10 endocrinologists and 2 general surgeons with experience of 10-15 years of age have been discussed.

This group of doctors' specialist has been working in affiliated hospitals of Shahid Beheshti University of Medical Sciences in Tehran verification has been carried out in Taleghani, Modarres and Imam Khomeini hospitals. The research consists of two phases: the descriptive phase and the development phase, each containing the various stages, which are described below:

Development phase

At this stage of the study, the features selected in the prevailing form of the survey, entitled "A survey form of the characteristics involved in the diagnosis of fatty liver", were gathered by the Microsoft Excel 2013 software, which is in the appendix. In this form for each characteristic feature of its measurement, various properties of the characteristic score from one to five and an option under the title "unnecessary" are considered. There is also a section for inserting comments for each feature and the view of the professors of surgery. In a follow-up questionnaire, in three separate tables, three systems of Alorado, Ripasa, and inflammatory system of Fatty Liver Disease were introduced to refer to them if it is necessary. In order to ensure the validity of the selected characteristics and to ensure that these features are really involved in the development of Fatty Liver Disease, the methods of Validation were used because of the ease and implementation of the formal method. In this way, a prepared questionnaire was provided to several general surgery specialists and they were asked to identify the maladaptive features in each of the scales used in the survey form. In this way, features that more than half of the experts did not recognize were inappropriate and inaccurate were replaced by external scale and more appropriate features, finally the remaining features were approved by a majority of experts. The choice of attribute and development of ANN models to determine the predictive power of characteristics, correlation and distribution of categorical variables used in two groups of patients were first analyzed by a multidimensional test ($p > 0.05$). As shown in Tables 1 and 2, between 15 categories of classification, eight and six important variables for 1-year and 2-year-old DFS were used as the input of ANN models. Furthermore, we also used 15 attributes as input to make ANN model for comparison. An ANN model can recognize data patterns via learning process and is used to support medical decision-making. In this study, a multi-layered MLP model was used with a retro-reflective learning law. After proper training, the neural network selects the network structure with the most satisfactory performance. The network model is consists of an input layer, a hidden layer and an output layer. The output layer processing unit also received the input value from the hidden layer to predict the output. Figure 1 shows ANN networks for various features and purposes (DFS 1 year or 2 years old) used in this study. ANN models using the ANN tool embedded in Statistica10.0 (StatSoft, Inc., Tulsa, Oklahoma, USA). The MLP neural networks were selected with backward-training algorithms for constructing the model. It also provides computational methods with a number of hidden layers to select potential models for users. Cross-validation was applied to the training group of 80% and the test group of 20% to express the definitions of the models.

Validating data

To validate the models, this study used sensitivity, feature, predicted accuracy, and range under the receiver performance characteristic curve to evaluate their predicted strength. Then, two types of validation tests were carried out using past data or data generated through future simulations. To validate the models, this study used sensitivity, feature, predicted accuracy, and range under the receiver performance characteristic curve to evaluate their predicted strength. Then, two types of validation tests were carried out using past data or data generated through future simulations.

Finally, these models were compared to determine a desired prediction model with respect to the distinct input variables. In fact, models are built for the future program to gather the test set after making the models. Such a study is a prospective study. Therefore, we designed a validation method to simulate a possible situation in order to show the nearly true results of the application. We considered the data before November 2015 as training data and those who used survey data since November 2015. So, the participants received the training group from January 2009 to November 2015 that 202 patients were assigned to the 1-year training group and 143 to the two-year training group. The receiving patients (50 and 36 in Group 1 and 2) were used as data to validate the model. As internal validity, four models were constructed for evaluation. Models 5 and 6 are a 1 - year model with all 15 variables and eight significant variables. Models 7 and 8 are two - year models with all 15 variables and 6 significant variables. Finally, effectiveness included accuracy of validation and analysis.

Data Analysis

Classification of data: in this study, three methods have been used for classification of data, which is explained in the continuation of each method.

Classification of data from the MLP network

Classification of data by SVM network:

Classification of data with SVM network with kernel:

The accuracy of a system in the classification of data is the measure of the performance of the system in the correct classification of input patterns. This parameter shows how many healthy people are properly classified as healthy and how many patients are properly classified as patients. The accuracy is obtained from the following relationship.

$$\text{Accuracy} = \frac{\text{TP} + \text{TN}}{\text{TP} + \text{FN} + \text{TN} + \text{FP}} \times 100$$

That:

TP1 : The number of people diagnosed correctly as a patient.

TN2: The number of healthy people who are properly diagnosed as a healthy.

FN3: The number of people who have been incorrectly diagnosed as a healthy.

FP4: The number of healthy people who have been incorrectly as patients.

Characteristic: The characteristic of a system in data classification is a measure showing the system performance in the correct classification of healthy people. This parameter shows how many healthy people are properly classified as healthy people. The characteristic is derived from the following relationship.

$$\text{Specificity} = \frac{\text{TN}}{\text{TN} + \text{FP}} \times 100$$

Sensitivity: The sensitivity of a system in the classification of data is a measure that indicates the system performance in the correct classification of the patient. This parameter shows how many patients are properly classified as patients. The sensitivity is derived from the following relationship.

$$\text{sensitivity} = \frac{\text{TP}}{\text{TP} + \text{FN}} \times 100$$

Validation: In order to evaluate the systems designed in the data classification, some data are used as training data and some of the others as test data. In the evaluation of neural networks, 10 - 20 % of the data is used for network testing and the rest for network training.

To evaluate the accuracy of classification systems, cross - sectional cross - sectional method has been used. In this method, the total data are randomly divided into K equal parts. The evaluation is performed at K. In each phase, an approximate part of the data is used to train the network and a remaining part to test the accuracy of its performance. In each stage part that is used for the experiment, it different from the preceding steps. Finally, the average accuracy, feature and sensitivity of different steps have been reported as accuracy, specification and final sensitivity of the system. In figure of this process, it is shown schematically. In this figure, the entire data is divided into five sections, in each stage four sections are used as training data and one part as test data.

In this section, we design and optimize an MLP network for data classification. To design an MLP network, we need to determine the number of neurons in the input layer, the number of hidden layers, the number of neurons available in each hidden layer as well as the number of neurons present in the hidden layer. The number of neurons of the input layer is equal to the number of features extracted from the patients. The number of neurons available in the output layer is considered equivalent to one. If the output value of this neuron exceeds the threshold, the output is assumed to be one and means that these attributes belong to a patient. Whereas the output value of this neuron is lower than the threshold, it indicates that the person is healthy and used as a transmission function in all neurons.

Table 4 - The accuracy, sensitivity and characteristics of the MLP network

Input layer neurons	The first hidden layer neurons	Second Hidden Layer Neurons	Output layer neurons	
Network structure				Number of features
1631121				16
152381				15
1433111				14
132281				13
1225141				12
111891				11

The charts below show the accuracy, sensitivity and characteristics of the designed MLP network for a number of different features. As defined by reducing the number of attributes, the performance of the classifier system decreases.

In this study, with regard to the study of diseases and the use of new technologies in medical science, the research showed that the application of neural network in modeling and detection of diseases was very efficient, and this study also used artificial neural network for modeling and detection of fatty liver disease.

For testing and verifying the data, a number of samples were not used in the neural network modeling process to be used for testing. Then the same samples were used to test the model and the results showed that the model works correctly. As shown in Fig. 4.3, here is a neural network with three inputs and an output of 5 internal layers and an output layer.

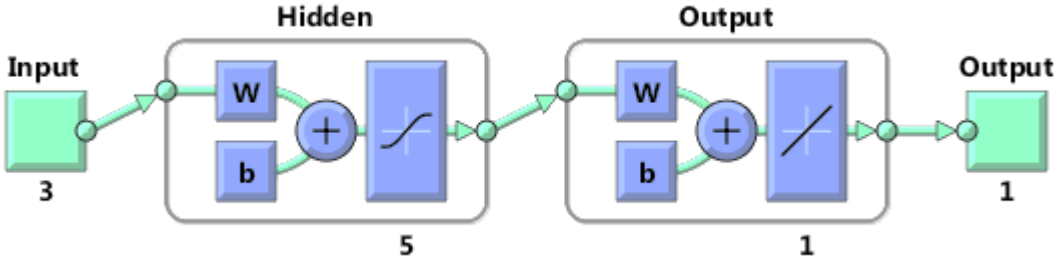
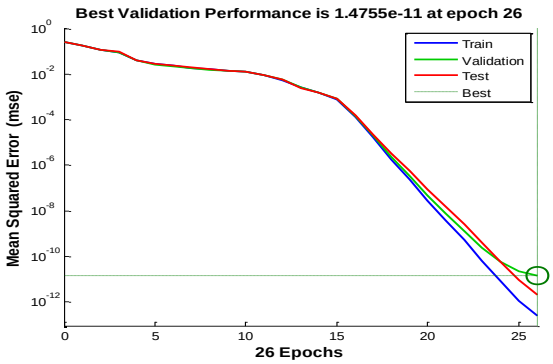


Figure 2 Neural networks with 5 inner layers



We want to model the properties of patients with fatty liver by this neural network. The procedure is that we have a collection of data from the 9547 people who have applied for the problem of fatty liver. In this information, According to the information of these people, we want to anticipate any other person who has a visit, without examining his liver, whether he is in the first category or the second category.

patients are divided into two categories in the columns corresponding to the results of the first group of patients with number 1 and the second group with number 2.

After doing the learning, the output of the program is as follows. Figure 3 is the root mean squared error or root mean square deviation, and is the difference between the predicted value of the model or the statistical estimator and the real value.

Figure 3: Changes in the step of training during repetitions

Square root mean square error for all three training data, testing and evaluation

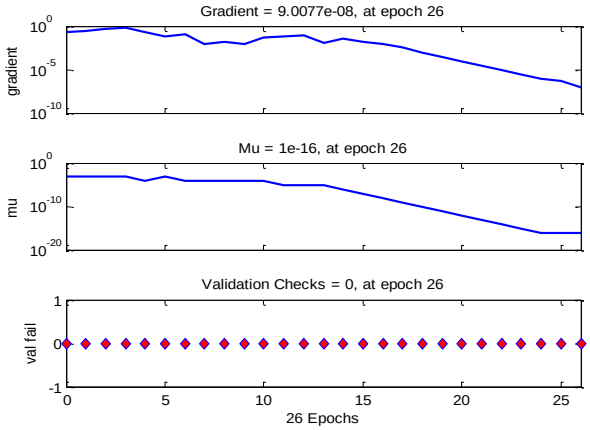


Figure 4 shows the rate of each category of data in return for different faults

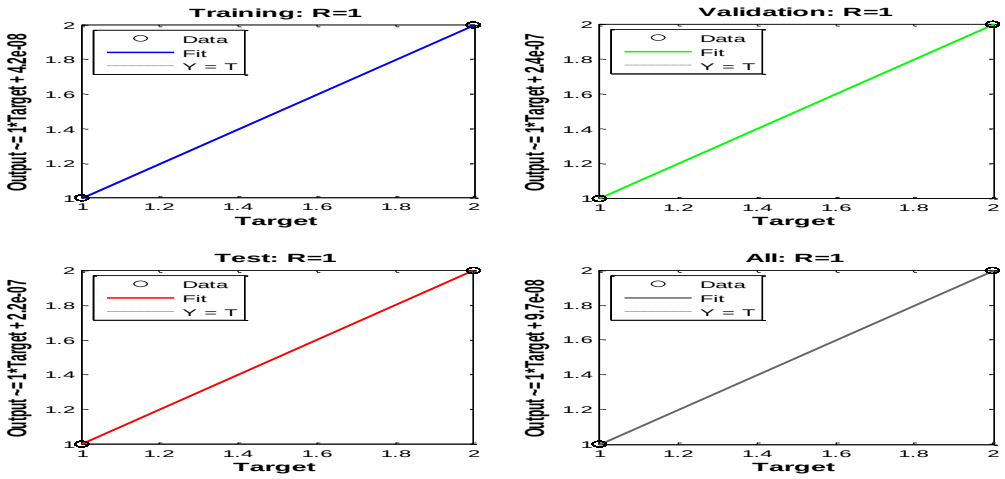


Figure 5: The amount of network output difference with actual value

The results show that the neural network model has a low error and high explanatory power and therefore has good predictive power. Now you can check the status of your liver fat by taking information in 3 steps from each person you visit.

Conclusions

In this paper, a new model is implemented to identify fatty liver disease based on artificial neural networks. According to the information from the fatty liver patients and these patients are divided into two categories, we model the input and output relationship of the information using neural network. So that according to the model obtained in this project one can predict the status of the new client with very high precision. Artificial neural networks are used as one of the computational methods in artificial intelligence of systems and modern computational methods that are used for machine learning, knowledge representation, and finally applying knowledge acquired in order to generate output responses from complex systems. The main idea of such networks is inspired by the way of function of biological neural system, for data processing, and information in order to learn and create knowledge. The key element of this idea is to create new structures for the information processing system. The system consists of a large number of super-integrated

processing elements called neurons that work together to solve a problem and transmit information through synapses (electromagnetic communications). In these networks, if a cell is damaged, the rest of the cells can compensate for it and also contribute to its reconstruction.

The results show that the neural network model has a low error and high explanatory power and therefore has good predictive power. Now you can check the status of your liver fat by taking information in 3 steps from each person you visit

Offers:

Given that in this project the condition of hepatic patients is proposed, the condition of heart patients, kidney, etc. has been proposed and model for prediction of their condition.

Because the neural network can model any problem, we can find things that are not subject to themselves and that the best inputs are unknown. In such cases, we first model the function in the neural network and then use one of optimization problems such as genetic algorithm, which is the combination of neural network and genetic algorithm

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