UACEE International Journal of Artificial Intelligence and Neural Networks – IJAINN
Volume 3 : Issue 2 [ISSN 2250 – 3749]
Publication Date : 05 June 2013

An Approach to Pancreatic Cancer Detection using Artificial Neural Network

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***Abstract* - Cancer is a class of diseases characterized by out-of-control cell growth and pancreatic cancer (PC) occurs when this uncontrolled cell growth begins in the pancreas. If it is malignant and not detected at early stages, it may cause death. The aim of this paper is to present artificial neural network in pancreatic disease diagnosis based on a set of symptoms. The real procedure of medical diagnosis which usually is employed by physicians was analyzed and converted to a machine implementable format. This paper presents an approach to detect the various stages of pancreatic cancer affected patients. Outcome suggests the effectiveness of using neural network over manual detection procedure.**

Keyword: Neural network, fuzzy logic, medical diagnosis, pancreatic cancer, literature review.

I. Introduction

Medical Disease Diagnosis using Artificial Neural Networks (ANN) [1] is currently a very active research domain in medicine and it is believed that it will be more widely used in biomedical systems in the next few years. Neural networks (NN) techniques have recently been applied to many medical diagnosis problems [2] [3]. Most applications of artificial neural networks to medicine are classification problems; that is, the task is on the basis of the measured features to assign the patient to one of a small set of classes. Several research groups are working world wide on the development of neural networks in medical diagnosis [4] [5]. Neural networks are used to increase the accuracy and objectivity of medical diagnosis. An ANN is a network of interconnecting processing elements (neurons) operating in parallel. These elements are inspired by biological nervous systems. As in nature, the connections between elements largely determine the network function. A subgroup of processing element is called a layer in the network. The first layer is the input layer and the last layer is the output layer. Between the input and output layer, there may be additional layer(s) of units, called hidden layer(s). One can train a neural network to perform a particular function by adjusting the values of the connections (weights) between elements. Pancreatic cancer is the fourth most common cause of cancer-related deaths in the United States and the eighth worldwide.

Pancreatic cancer is of malignant type neoplasm originates from transformed cells arising in tissues form the pancreas. Pancreas is a 6-inch long spongy organ located behind the stomach in the back of the abdomen. The pancreas contains exocrine and endocrine glands that create pancreatic juices, hormones, and insulin. Pancreatic juices, or enzymes, made by the exocrine glands are released into the intestines by way of a series of ducts in order to help digest fat, proteins, and carbohydrates. The endocrine cells are arranged in small clusters called islets of Langerhans, which release insulin and glucagon into the bloodstream. These two hormones manage levels of sugar in the blood. When they are not working properly, the result is often diabetes. The abnormal pancreas tissues continue dividing and form lumps or masses of tissue called tumours. Tumours then interfere with the main functions of the pancreas. If a tumour stays in one spot and demonstrates limited growth, it is generally considered to be benign.

The aim of this approach is to show that neural networks can make an accurate individualized prognosis of a patient given his or her particular condition [6] [7]. The need of designing a system that would help to diagnose of pancreatic cancer cannot be over emphasized. This paper demonstrates the practical application of human intelligence in the health sector [8] [9]. In diagnosis of pancreatic cancer using neural network provides a self-learning intelligent system that is capable of tackling uncertainties in the diagnosis process. This paper provides the information of the patients whether they have pancreatic cancer or not. This diagnosis is functioning depending on some symptoms which has been taken from their previous medical records and physician and train these symptoms through neural network to detect which patient is suffering from pancreatic cancer or he/she might be suffering from pancreatic cancer or may not suffer at all. The neural network using fuzzified symptoms values is applied in this approach to diagnosis pancreatic cancer properly.

In recent years neural network based methods have been widely used in prediction, especially in medical diagnosis [10] [11]. A review of literature reveals that artificial neural network have been used successfully to diagnose different medical diseases. Kamruzzaman et al. proposed a neural network ensemble based methodology for diagnosing of the heart disease medical disease diagnosis [12] in 2004. In 2008, Das and Bhattacharya implemented [13] genetic algorithm (GA) based Neuro Fuzzy Techniques for breast cancer

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identification and adaptive neuro fuzzy classifier has been introduced to classify the tumour mass in breast. Later Payandeh [14] et al. developed a new method for Diagnosis and Predicting Blood Disorder and Cancer Using ANN. Bahar et al. analyzed ANN for prediction of headache in this year [15]. This analysis has been done to investigate the ability of neural networks to detect and classify the complete improvement of headache in elderly patients during the follow- up period. Ganesan et al. applied neural network to diagnose cancer [16] in 2010. It has been used to analyze demographic data from lung cancer patients with a view to develop diagnostic algorithms that might improve triage practices in the emergency department. A number of neural network based disease diagnosis have been done in 2011. In this year Bekir used back-propagation and the Navie Bayes classifier for hepatitis diagnosis [17]. This study presents a comparison between Backpropagation and Naive Bayes Classifiers to diagnose hepatitis disease. Sumathi et al. constructed ANN to pre-diagnosis of hypertension [18]. The authors used ANN for solving the problems of hypertension diagnosing using Back-Propagation learning algorithm. Bakpo et al. also used ANN to diagnose of skin disease [19]. Elveren et al. presented a design using ANN and GA [20] for tuberculosis diagnosis. This article explained a study on tuberculosis diagnosis, carried out with the help of multilayer neural networks (MLNN). Recently, Kumar et al. introduced ANN for diagnosis of kidney stone disease [21]. Pandey et al. approached evolutionary modular neural network for breast cancer diagnosis [22]. Zhang et al. applied fuzzy neural network for survey work on medicine. In their study, the author reviewed [23] the position of the art for the application of fuzzy neural network in diagnosis, recognition, image processing and intelligence robot control of medicine. Saxena et al. have done a survey on classification of breast cancer data using neural network techniques[24].

II. Methodology

This medical diagnosis process was started by diagnosing the symptoms of a number of patients by a group of medical experts. Collected data set included the patient's previous state of health, living condition and other medical conditions. A neural network is proposed to diagnosis PC diseases. It consists of three layers: the input layer, a hidden layer, and the output layer. A one hidden with 20 hidden layer neurons is created and trained. The input and target samples are automatically divided into training, validation and test sets. The training set is used to teach the network. Training continues as long as the network continues improving on the validation set. The test set provides a completely independent measure of network accuracy. The hidden neurons are able to learn the pattern in data during the training phase and mapping the relationship between input and output pairs. Each neuron in the hidden layer uses a transfer function to process data it receives from input layer and then transfers the processed information to the output neurons for further processing using a transfer function in each neuron.

A. Dataset

Table 1 shows a part of the used input data set. This data set provides 11 symptoms and 3 categories of pancreatic diseases. The complete dataset contains a measured feature of 120 patients where 90 samples were used to train the network and 30 samples were used for training purpose. The set of symptoms are S= {Weight Loss, Jaundice, Irritability, Gallbladder enlargement, Deep venous thrombosis (DVT), Swelling lymph, Diabetes mellitus, Loss of appetite, Pain in upper abdomen, Acholic Stool & steatorrhea and Falty tissue abnormalities}. The set of diagnosis are D = {detected, might be detected and not detected}. Disease name and their assigned labels are mentioned in table II. According to the basis of fuzzy set, this article describes each symptom by its membership value $\mu_A(x)$. Operational procedure is presented in fig. 2.

B. Training of parameters

Once a network has been structured for a particular application, that network is ready to be trained. To start this process the initial weights are chosen randomly. Then the training or learning begins. The ANN has been trained by exposing it to sets of existing data (based on the follow up history of various patients) where the outcome is known. The hidden neurons are able to learn the pattern in data during the training phase and mapping the relationship between input and output pairs. Each neuron in the hidden layer uses a transfer function to process data it receives from input layer and then transfers the processed information to the output neurons for further processing using a transfer function in each neuron.

III. Result and discussion

Neural network toolbox from Matlab R2008a is used to evaluate the performance of the proposed networks where a three layer feed forward network with 11 number of inputs and sigmoid hidden neurons and linear output neurons is suggested. The proposed neural network is shown in Fig. 1. This paper used Levenberg-Marquardt back propagation algorithm to train the network where training automatically stops when generalization stops improving, as indicated by

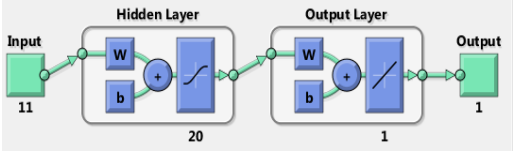

Figure 1. Proposed Neural Network

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TABLE1. MEDICAL KNOWLEDGEBASE TABLE

Weight loss	jaundice	Irritability	GB enlargement	DVT	Swelling Lymph	DM	Loss of appetite	pain inupper abdomen	AS & steatorrhea	Faulty tissue abnormalities	Result
0.60	0.45	0.30	0.10	0.55	0.35	0.15	0.26	0.80	0.72	0.18	1
0.62	0.18	0.17	0.78	0.14	0.82	0.50	0.00	0.59	0.36	0.47	2
0.32	0.73	0.25	0.55	0.61	0.13	0.20	0.69	0.33	0.49	0.86	2
0.28	0.24	0.39	0.36	0.23	0.70	0.55	0.63	0.08	0.17	0.63	3
0.43	0.59	0.73	0.29	0.70	0.37	0.13	0.68	0.75	0.55	0.43	1
0.56	0.44	0.57	0.63	0.34	0.19	0.41	0.53	0.69	0.72	0.38	1
0.72	0.52	0.60	0.19	0.42	0.40	0.21	0.63	0.30	0.39	0.52	3
0.63	0.13	0.11	0.47	0.69	0.23	0.51	0.12	0.24	0.10	0.63	2
0.33	0.63	0.49	0.72	0.77	0.62	0.24	0.38	0.21	0.43	0.40	1
0.78	0.24	0.54	0.41	0.64	0.78	0.43	0.55	0.30	0.18	0.23	1

TABLE 2. DISEASE AND ASSIGNED LABEL

Disease	Assigned Label
PC Detected	1
PC Might be detected	2
PC Not detected	3

an increase in the mean square error (MSE) of the validation samples. This study has used a membership based fuzzification scheme on our dataset to convert it to a fuzzified set of symptoms. A linear membership function was selected for each symptom again after an interview with physicians. Normally three to five linguistic variables were assigned to each symptom, then the classification tests were repeated.

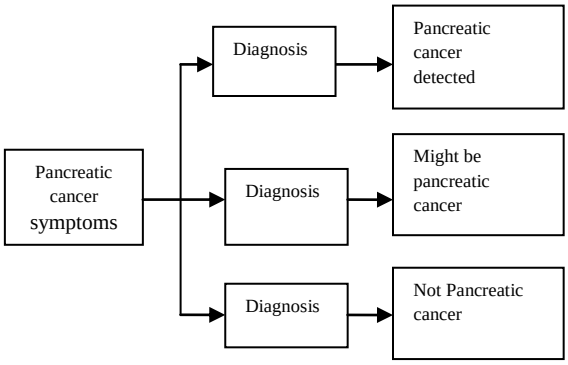

Figure 2. Operational procedure

Fig. 3 shows the used fuzzy inference system (FIS) editor and fig. 4 shows membership function editor. Performance plot editor is displayed in fig. 5.

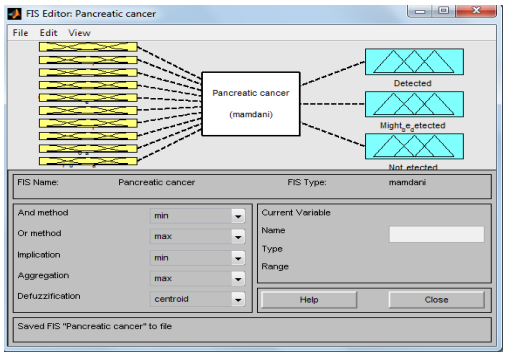

Figure 3. FIS editor

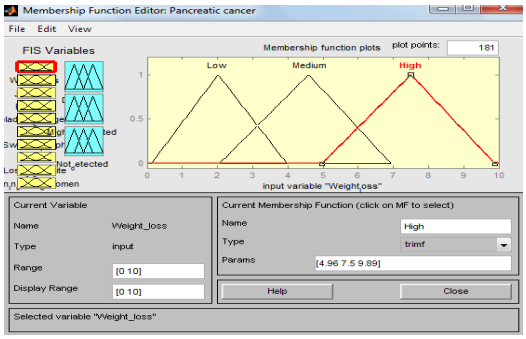

Figure 4. Membership function editor

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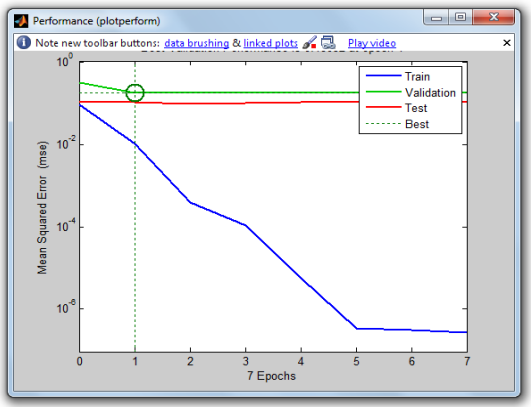

Figure 5. Performance plot

The results of applying the artificial neural networks methodology to distinguish between PC affected non affected person based upon selected symptoms showed very good abilities of the network to learn the patterns corresponding to symptoms of the person. Our experimental result is presented in table 3.

IV. Conclusion

In this paper we have presented a neural network based approach for pancreatic cancer diagnosis. Pancreatic cancer detection in its early stage is the key of its cure. The automatic diagnosis of pancreatic cancer is an important, real-world medical problem. In this paper it has shown how neural networks are used in actual clinical diagnosis of pancreatic cancer. Neural network model, a diagnostic system that performs at an accuracy level is constructed here. In this work, the performance of neural network structure was investigated. The designed system uses a set of fuzzy values incorporated into neural network system is more precise than the normal system. The system designed is an interactive system that informs the patient his current condition as regards pancreatic cancer. The prediction could help doctor to plan for a better medication and provide the patient with early diagnosis. The best performance and correct diagnosis was achieved using fuzzified symptoms and neural network with 20 neurons. Experimental results indicate that the proposed method can analyze data more efficiently than other manual methods. Future works should test the approach used for other similar tasks or other related data sets to evaluate its capability to produce a similar accuracy.

References

[1]. N. Salim, "Medical Diagnosis Using Neural Networks", 2004
[2]. W. David Aha and Dennis Kibler, "Instance-based prediction of heart disease presence with the Cleveland database"
[3]. J. W., Everhart, J. E., Dickson, W. C., Knowler, W. C., Johannes, R. S., "Using the ADAP learning algorithm to forecast the onset of diabetes mellitus", *Proc. Symp. on Computer Applications and Medical Care*, pp. 261–5, 1988.
[4]. J. W., Everhart, J. E., Dickson, W. C., Knowler, W. C., Johannes, R. S., "Using the ADAP learning algorithm to forecast the onset of diabetes mellitus", Proc. Symp. on Computer Applications and Medical Care, pp. 261–5, 1988.
[5]. Suvarna Mahavir Patil and R.R. Mudholkar, An Osteoarthritis classifier using back-propagation neural network, International Journal of Advances in Engineering & Technology, Sept 2012, ISSN: 2231-1963.
[6]. Obi J.C. Imianvan A.A, Interactive Neuro-Fuzzy Expert system for diagnosis of Luukemia, Global Journal of Computer Science and Technology, Volume 11 Issue 12 Version 1.0 July 2011.
[7]. Imianvan Anthony Agboizebeta., and Obi Jonathan Chukwuyeni, Application of Neuro-Fuzzy Expert System for the Probe and Prognosis of Thyroid Disorder, International Journal of Fuzzy Logic Systems (IJFLS) Vol.2, No.2, April 2012.
[8]. W. David Aha and Dennis Kibler, "Instance-based prediction of heart disease presence with the Cleveland database".
[9]. Prof. A. Maithili, Dr. R. Vasantha Kumari Mr. S. Rajamanickam, Neural networks towards medical, International Journal of Modern Engineering Research (IJMER), Vol.1, Issue1, pp-57-64 ISSN: 2249-6645.
[10]. Dr. Sarah Behnam Aziz, Thyroid disease diagnosis using Genetic Algorithm and Neural Network.
[11]. A.V. Senthil Kumar, Diagnosis of Heart Disease using Fuzzy Resolution Mechanism, Journal of Artificial Intelligence,2012, ISSN 1994-5450/ DOI: 10.3923/jai.2012.
[12]. S. M. Kamruzzaman, Ahmed Ryadh Hasan, Abu Bakar Siddiquee and Md. Ehsanul Hoque Mazumder, Medical diagnosis using neural network, ICECE 2004, 28-30 December 2004, Dhaka, Bangladesh.
[13]. Arpita Das and Mahua Bhattacharya, GA based Neuro Fuzzy Techniques for breast cancer Identification, IEEE, 978-7695-3332-2/08, 2008. DOI: 10.1109/IMVIP.2008.19
[14]. Payandeh M, Mehrnoush Aeinfar, Vahid Aeinfar, Mohsen Hayati, A New Method for Diagnosis and Predicting Blood Disorder and Cancer Using Artificial Intelligence (Artificial Neural Networks), IJHOSCR, Vol. 3, No.4; 2009.
[15]. Bahar TAŞDELEN, Sema HELVACI Hakan KALEAĞASI, Aynur ÖZGE, Artificial Neural Network Analysis for Prediction of Headache Prognosis in Elderly Patients, Turk J Med Sci,2009; 39 (1): 5-12,© TÜBİTAK, E-mail: medsci@tubitak.gov.tr DOI:10.3906/sag-0709-3.
[16]. Dr. N. Ganesan, Dr.K. Venkatesh, Dr. M. A. Rama, Application of Neural Networks in Diagnosing Cancer Disease Using Demographic Data, International Journal of Computer Applications (0975 - 8887), Volume 1 – No. 26, 2010.
[17]. Bekir KARLIK, hepatitis disease diagnosis using backpropagation and the naive bayes classifiers, Journal of Science and Technology, Volume : 1 / Number : 1 / Year :2011
[18]. B. Sumathi,Dr. A. Santhakumaran, Pre-Diagnosis of Hypertension Using Artificial Neural Network, Global Journal of Computer Science and Technology, Volume 11 Issue 2 Version 1.0 February 2011.
[19]. Bakpo, F. S. and Kabari, L. G, Diagnosing Skin Diseases Using an Artificial Neural Network, DOI:10.5772/16232.
[20]. Erhan Elveren, Nejat Yumusak, Tuberculosis Disease Diagnosis Using Artificial Neural Network Trained with Genetic Algorithm, Journal Of Medical System, June 2011, Volume 35, Issue 3, pp 329-332
[21]. Koushal Kumar, Abhishek Artificial Neural Networks for diagnosis of kidney stones disease, *I.J. Information Technology and Computer Science*, 2012, 7, 20-25 .
[22]. Bipul Pandey, Tarun Jain, Vishal Kothari and Tarush Grover, Evolutionary Modular Neural Network Approach for Breast Cancer Diagnosis, IJCSI International Journal of Computer Science Issues, Vol. 9, Issue 1, No 2, January 2012.
[23]. Hongmin Zhang, Xuefeng Dai, The Application of Fuzzy Neural Network in Medicine-A Survey, International Conference on Biological and Biomedical Sciences Advances in Biomedical Engineering, Vol.9, 2012.
[24]. Shweta Saxena, Kavita Burse, A Survey on Neural Network Techniques for Classification of Breast Cancer Data, International Journal of Engineering and Advanced Technology (IJEAT) ISSN: 2249 – 8958, Volume-2, Issue-1, October 2012.

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TABLE 3. EXPERIMENTAL RESULT

Weight loss	jaundice	Irritability	GB Enlargement	DVT	Swelling Lymph	DM	Loss of appetite	Pain in upper abdomen	AS&steatorrhea	Faulty tissue abnormalitie	Remarks
0.35	0.82	0.13	0.70	0.37	0.19	0.40	0.23	0.62	0.78	0.56	Affected
0.34	0.73	0.54	0.32	0.16	0.27	0.27	0.52	0.45	0.34	0.66	Affected
0.56	0.32	0.62	0.54	0.48	0.45	0.51	0.61	0.73	0.61	0.27	Might be affected
0.64	0.54	0.28	0.26	0.73	0.73	0.72	0.54	0.29	0.66	0.10	Not affected
0.85	0.17	0.19	0.63	0.72	0.62	0.54	0.81	0.10	0.71	0.79	Not affected
0.37	0.73	0.43	0.42	0.53	0.25	0.72	0.12	0.48	0.18	0.67	Affected
0.65	0.61	0.28	0.47	0.38	0.56	0.86	0.26	0.57	0.19	0.40	Not affected

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