Multilayer Perceptron Approach in Breast Cancer Diagnosis

Emine Avşar Aydin[1*], Gözde Saribaş[2]
1- Adana Alparslan Türkeş Science and Technology University, Department of Aerospace Engineering, Adana, Turkey.
Email: eaydin@atu.edu.tr or rasvaenime@gmail.com (Corresponding author)
2- Çukurova University, Department of Biomedical Engineering, Adana, Turkey.
Email: gozdesrbs@gmail.com

Received: August 2020 Revised: September 2020 Accepted: November 2020

ABSTRACT:
Many diseases cause death in people around the world. One of them is cancer, and many types of cancer diseases are seen today. One of the cancer types that cause the most death is Breast Cancer. Early diagnosis has an essential place in Breast Cancer as it is crucial in every disease. Thanks to early diagnosis, the patient's survival rate increases as a result of the treatment applied. Today, many studies are carried out and developed to be able to diagnose breast cancer early. The work done with the algorithms found in machine learning is just one example. In this paper, MLP (Multilayer Perceptron), which is one of the Machine Learning methods, and the algorithm in Breast Cancer Diagnosis is explained using the data collected in the Department of General Surgery, University Wisconsin, Center of Clinical Sciences.

KEYWORDS: Breast Cancer, Diagnosis, Machine Learning, Multilayer Perceptron.

1. INTRODUCTION

1.1. What is Breast Cancer?

Many types of diseases result in death worldwide, and cancer is the second disease with the highest mortality rate. If we want to define cancer, it is the uncontrolled division and proliferation of cells in an organ or tissue [1]. These cells, which increase uncontrollably, can metastasize, spread to other parts of the body, and cause the disease to recur in more than one region in the human body.

The success of treatment depends on diagnosing the disease early and starting treatment first. Tumors that divide and grow uncontrolled can be explained under two headings; these titles are benign and malignant tumors. Benign tumors do not have a risk of cancer, but malignant tumors cause cancer. In this case, early diagnosis is of great importance for the patient. The sooner the diagnosis is made, the treatment can be started before cancer spreads to other parts of the body, and the success rate of the patient's treatment will be high. Accurate diagnosis is as important as early diagnosis. Misdiagnosis negatively affects the mental health of the patient and leads to a decrease in treatment success.

The most common type of cancer in women all over the world is Breast Cancer. It is a disease caused by the uncontrolled division and proliferation of the cell group in the breast tissue. Over time, cancerous cells can invade healthy cells around them, reach the underarm lymph node, and spread (metastasize) to other parts of the body. Breast cancer can occur in a person at any age but is more common in postmenopausal women. Because of this situation, early diagnosis is vital in breast cancer [2]

1.2. Breast Cancer Risk Factors

When a patient is diagnosed with cancer, there are some risk factors to consider. These risk factors are grouped under two headings (Table 1).

Table 1. Breast Cancer Risk Factors.

Preventable Risks	Unchangeable Risks
Active Life	Density in breast tissue
	Age
	Gender
Balanced diet	
	Early menstrual cycle or late menopause
Reducing and stopping alcohol and cigarette consumption	Estrogen Hormone
	Family history

Paper type: Research paper
DOI: https://doi.org/10.29252/mjtd.9.4.163
How to cite this paper: E. Avşar Aydin, G Saribas, **"Multilayer Perceptron Approach in Breast Cancer Diagnosis"** *Majlesi Journal of Telecommunication Devices*, Vol. 9, No. 4, pp. 163-166, 2020.

Their diet (vegetarian, vegan, etc.) is effective in cancer. Postmenopausal (postmenopausal) weight gain and obesity in women increase the risk of breast cancer.

2. MATERIALS AND METHODS

2.1. Materials

This study was conducted on breast cancer data collected in the open-access William H. Wolberg, Department of General Surgery, University Wisconsin, Clinical Sciences Center [3].

Table 2. Dataset Content.

Features	Number of Features
Number of Instances	569
Number of Features	32
Class	- Benign Tumor - Malignant Tumor
Class Distribution	- Benign: 357 - Malignant: 212

2.2. Methods

2.2.1. Multilayer Perceptron

Machine Learning is one of the most frequently used methods when it is necessary to analyze the obtained data while producing solutions for the problem, which is mainly present in many areas today. There are many types of algorithms in machine learning. One of them is the Multilayer Perceptron (MLP) algorithm. MLP algorithm works effectively in classification and generalization studies. Classification is an essential part of machine learning [4].

The perceptron algorithm, which forms the basis of the Multilayer Perceptron model, was invented by Frank Rosenblatt, funded by the United States Maritime Research Department at the Cornell Aviation Laboratory in 1957.

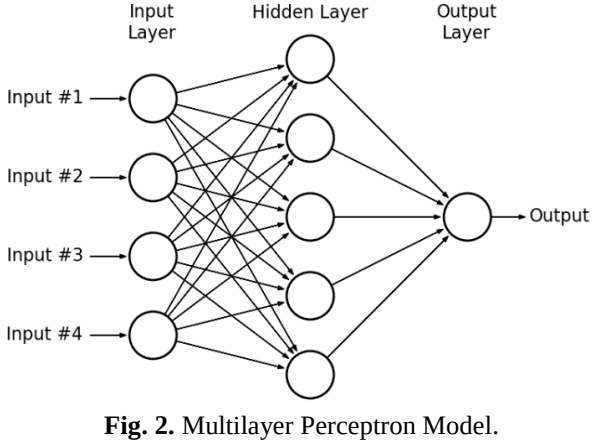

Fig. 2. Multilayer Perceptron Model.

Multilayer perceptron (MLP) has been used to solve complex problems from past to present [5]. The Multilayer sensor consists of 3 parts. These are input, hidden layer, and output. Each section has sensors called neurons, and each neuron is linked to all neurons in the next layer, and each connection has a weight value. Each layer can have multiple sensors or multiple layers. Multilayer sensors can become a complex system depending on the layer it contains and the number of sensors in each layer.

The most important feature that distinguishes the Multilayer Perceptron model from the Perceptron model is that it has at least one hidden layer. Hence the term multilayered. Each sensor in the first layer on the left (input layer) sends outputs to all sensors in the second layer (hidden layer), and all sensors in the second layer output to the last layer on the right (output layer) (Fig 2).

Multilayer Perceptron is a controlled training algorithm. It is also called the "Back Propagation Model" or "Error Propagation Model" because it propagates the error to the network [43]. The input and output data are supplied to the model, and the algorithm will learn by using this data and establishing an equation between them. The learning method used in the model is the "Delta learning rule."

The model stated that in the connections between neurons, each link has a weight value. The program initially assigns this weight value as random values . These weight values are updated during the training period when the program establishes a relationship between input and output values [4]. The most common method used to find accurate weight values is the backpropagation method.

Another situation that matters in an artificial neural network model is the activation function. When the activation function is not used in a neural training network, the network acts as a linear function and performs its training accordingly. This situation means that the model cannot learn in the face of nonlinear values , and the learning achievement of the network will decrease.

An activation function (nonlinear function) is required for the model to avoid this situation and avoid any problems in the neural network's learning process. The activation function is applied to the output value obtained by multiplying the input value x by the weight value w. It is also essential to use the model's bias value and the activation function in an artificial neural network model.

In some cases, the input value given to the neural network can be 0; in this case, when the input value is multiplied by the weight, the output value becomes 0. 0 output value negatively affects the learning process of the network. In this case, a bias value must be added to the function. The bias value prevents the part's output value from being 0 and contributes to the continuation of the neural network's learning process.

Each layer's output value becomes the next layer's input by applying the multilayer sensor's activation function. This process is repeated throughout the

intermediate layers. The neural network's output value is the classified state of the input values given to the model. The output value can be classified as 0 or 1 in line with an absolute threshold value.

The MLP model used in this paper was created in a python environment. The model consists of input, four hidden layers, and output. There are 50 neurons in each hidden layer.

In an MLP model, the user can use the trial and error method to determine the number of layers and neurons. The most suitable model for the study can be created by comparing the results with the changes made in the number of layers and neurons in the model [6,7].

3. MODEL EVALUATION

The data contained in the dataset were examined (inputs). The dataset was introduced to the algorithm, and the Input values and Output values were grouped into two different datasets. Input values are standardized between -1.1. For the algorithm to pass to the training phase, input and output data were divided into two groups: "train" and "test," and the train/test ratio was selected as 33%.

The neural network training was started by giving training data and output values to the created artificial neural network. In testing the artificial neural network model, only the test data's input values were given to the algorithm, and the neural network predicted which class the result belongs to according to the input values. The algorithm's accuracy rate was calculated by comparing the output values obtained after the algorithm's estimation stage with the test data's actual output values.

3.1. Accuracy

The algorithm's success is related to the number of correctly predicted samples and incorrectly predicted models. The performance information of the results obtained from the test can be expressed with the confusion matrix. In the confusion matrix, the rows represent the real numbers of the samples in the test set, and the columns represent the estimation of the model. Technical work (Table 3).

Table 3. Confusion Martix TP: True Pozitif, TN: True Negatif, FP: False Pozitif , FN: False Negatif.

Accuracy Class	**Predicted Class**	**Predicted Class**
Class 1 (Benign)	TP	FN
Class 2 (Malignant)	FP	TN

Accuracy ratio is a method used to measure model performance (1). It is the ratio of correctly classified samples (TP + TN) to the total number of pieces (TP + TN + FP + FN).

$$Accuracy = \frac{TP+TN}{TP+TN+FP+FN} \quad (1)$$

4. RESULTS AND DISCUSSION

The activation function to be used in the artificial neural network model can be determined by looking at the model's accuracy due to the different activation functions used (Table 4).

Table 4. Results.

Activation Function	Accuracy
Relu	98.5%
Tanh	97.8%
Logistic	96.4%

In line with the study results, Relu has shown higher success as an activation function. In the model, the activation function relu is selected. The success rate of the model is 98.9%.

Another factor inaccuracy is the input values in the data set. It is essential to know the effect of the given input values on the output value and add them to the algorithm. The accuracy rate will vary depending on the Deep learning method used. This work can be improved, and the accuracy rate can be increased.

5. CONCLUSION

The artificial neural network models are actively used in health and many different areas, such as early diagnosis of diseases. The model used must be at a level that can provide an effective solution to the existing problem, and the right model is selected according to this situation. The input values used as independent variables in the chosen model are essential for the output value, the dependent variable. The input values that do not affect the output affect the model training negatively. The artificial neural network model created has achieved 98.9% success for disease diagnosis. The success rate may increase depending on the artificial neural network model used and the activation function used. Studying is open to development.

REFERENCES

[1] F. E. Aslan and A. Gürkan, "**Kadinlarda meme kanseri risk düzeyi,**" *Meme Sağliği Derg.*, Vol. 3, pp. 63–68, 2007.

[2] Acıbadem, "***Kanser Nedir?***," *T.C. Sağlık Bakanlığı Halk Sağlığı Genel Müdürlüğü Kanser Dairesi Başkanlığı*, 1991., Retrieved from https://www.acibadem.com.tr/acibadem-de/kanser-onkoloji/

[3] Dua, D. and Graff, C. (2019). UCI Machine Learning Repositor, Retrieved from [http://archive.ics.uci.edu/ml]. Irvine, CA: University of California, School of Information and Computer Science.

[4] O. TAŞOVA, "**Yapay sinir ağları ile yüz tanıma.**"

DEÜ Fen Bilimleri Enstitüsü, 2011.

[5] G. E. Hinton, S. Osindero, and Y.-W. Teh, "**A fast learning algorithm for deep belief nets,**" *Neural Comput.*, Vol. 18, No. 7, pp. 1527–1554, 2006.

[6] A. G. Parlos, B. Fernandez, A. F. Atiya, J. Muthusami, and W. K. Tsai, "**An accelerated learning algorithm for multilayer perceptron networks**," *IEEE Trans. Neural Networks*, Vol. 5, No. 3, pp. 493–497, 1994.

[7] Stephen, "**Perceptron-based learning algorithms**," *IEEE Trans. neural networks*, Vol. 50, No. 2, p. 179, 1990.

[8] Veri Madenciliğinde Sınıflandırma Algoritmalarının Bir Örnek Üzerinde Karşılaştırılması Cengiz COŞKUN1, Yrd. Doç. Dr. Abdullah BAYKAL2