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Provide Neural Network Prediction Model for Early Detection of Breast Cancer

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ABSTRACT

Breast cancer is a malignant mass in which breast tissue cells divide without any control due to genetic disorders such as mutations, chromosomal enhancement, deletion, reorganization, displacement, and recurrence. The diagnosis with breast cancer is very time-consuming. If the disease is diagnosed sooner than five years from the first cell deviation, this will increase the patient's chances of survival from 56% to more than 86%, which is very high. Data Mining is a new method for early detection and prognosis of breast cancer. The way presented in the present study will provide a model for predicting and early detection of breast cancer that will help take a step forward with the help of data mining and neural network techniques. This study examines the neural model for diagnosing breast cancer by data analysis on age, weight, age of onset of menopause, age of menopause, duration of OCP use, period of first pregnancy, family history, exercise, and some months of breastfeeding as inputs and disease variables Breast cancer as the output of the feed neural network with the Levenberg-Marquardt post-diffusion learning algorithm and the study of estimating the accuracy of the models by MSE and RMSE methods determined to the principle of multilayer neural networking algorithm has a good result. Also, according to the sensitivity analysis, it was determined that family history is more important, and less important are the variables of age, weight, age of onset of menstruation, and the number of months of breastfeeding. According to the importance of personal information in early detection of breast cancer, the efficiency of the Internet of Things in smart cities can be exploited.

1. Introduction

Breast cancer has a high mortality rate among women, which is Often known as the leading cause of death among women. Commonly, this type of cancer is diagnosed by a kind of surgery, which is the most accurate method among the available techniques. While, this surgery is costly, and its surgical process is very invasive, and is also causes anxiety, psychological and emotional problems for a patient. These issues lead to the use of prediction systems in various fields of medicine(Akbari et al., 2008). In Iran, cancer is the third leading cause of death, and among cancers, breast cancer is the most common among Iranian women (McLaughlin et al., 2006). If this time not be more than about five years from the first cell deviation, the patient's survival chances will be increased from 56% to more than 86%, that is very high. Therefore, having an accurate and achievable detection system at the right time is very important. Breast cancer usually has the second-highest rate of disease after lung cancer and is the first and highest rate among female cancers, and the condition is responsible for more than one-fifth of all cancer deaths in women (Zhaohui, 2008). According to reports of World Health Organization, the annual incidence of breast cancer increases by 1.8 to 2 percent. The age of mortality from of breast cancer in developed countries is between 55 and 60 years, while this age in Iran is between 40 and 49 years; Therefore, in Iran,the age of mortality by breast cancer is ten years lower than developed countries, at least.Due to the pivotal role of women in the family and society at these ages, caused mortality and disability by this disease cause irreparable damage to society and the family and society, mortality and disability caused by the disease cause irreparable damage to society and the family (Akbari et al., 2008). Therefore, prediction and early diagnosis of breast cancer is one of the fundamental challenges to community health and will provide timely treatment of the disease. (Saeedi et al.,

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2015). For this diagnosis, many factors such as the presence of the mass, lymph node involvement, nipple indentation, the occurrence of discharge in the breast, etc. are considered (Bronicardi et al., 2019). Data mining, which is defined as the process of discovering and extracting hidden patterns from large volumes of data, represents a large set of algorithms and techniques, and is inferred from sciences such as statistics, machine learning, databases, and visualization. It is finding a pattern in which existing data can be developed and using a known model to make decisions about future data, All of these processes are designed to creat a hypothesis based on the pattern discovered from the raw data. (Mahtabi and Parvin Nia, in 2018)

Mahtabi and Parvin Nia, in 2018, investigated the subject of breast cancer prediction using a combined algorithm of colonial competition and random forest. Researchers are trying to use data mining as a tool in the service of medical science. This article attempts to improve the accuracy of diagnosing the survival effects in people with breast cancer by analyzing and exploring the data stored in breast cancer centers. Therefore, in this study, an approach to increase the diagnosis of breast cancer is presented. This study uses data from the Seer Cancer Research Center, which has 149 features. In this study, a combination of colonial competition and random forest algorithms has been used to improve the diagnosis of survival diagnosis of people with breast cancer. Initially, the feature pre-processing operation was performed using the colonial competition algorithm, and finally, the classification operation was performed using the random forest algorithm. Combining these two algorithms has improved this approach compared to other algorithms. (Mahtabi and Parvin Nia in 2018)

Sarhadi et al. In 2018, investigated the diagnosis of breast cancer using SVM. Breast cancer is the most common type of cancer in women, affecting about 10% of women throughout their lives. Breast cancer is a malignant growth of cancer cells in the breast tissue. Breast cancer is one of the most common cancers in women, but it is cancer. It is also seen among men.

The earlier breast cancer is diagnosed, the easier and more successful it is to treat. For this reason, women must know the facts about this disease to maintain their health. Methodology: The data collected in this study is obtained from the data available in the database of Shahid Motahari Breast Cancer Clinic in Shiraz.(Sarhadi et al. In 2018)

This data includes two tables of patient details and information about patient referrals. Among these data, according to the physician's opinion, the fields that are very effective and important in diagnosing breast cancer were selected. This research has diagnosed breast cancer with the help of data mining to help physicians in medical science with the use of computer science. In this research, we have done this with the use of three techniques: SVM, SVM PSO, and hyper (SVM). SVM showed the highest accuracy with 100% accuracy. (Sarhadi et al. In 2018)Discussion and Conclusion: In this study, considering the importance of local models in diagnosing breast cancer, by preparing a data set from Shahid Motahari Clinic in Shiraz, the mentioned operations were performed on the samples. The SVM method showed the highest accuracy and efficiency with 100%. The present study is also compared with 2 works in 2018..(Sarhadi et al. In 2018)

2. Research Method

The purpose of this study is to present a neural network prediction model for IoT-based breast cancer in smart cities with a practical goal and a descriptive-analytical method. According to the purpose of the research, first, the factors affecting breast cancer are identified, and then the data are collected. The present study is descriptive in terms of the type of applied goal, descriptive in terms of controlling variables, and library in terms of the data collection method. To cover the theoretical topics of the research, general and specialized books, articles, and technical publications have been used. In this study, the statistical society includes Shariati Hospital in Tehran province.

According to the nature of the research, sampling was not done from the community, and the whole community was surveyed. Components that can medically help in diagnosing the type of this disease are considered as data features. By identifying the input and output components, the prediction model is first formed using neural networks. For prediction based on neural networks, three necessary and fundamental steps are suggested:

Pre-Processing, Architecture, Post-Processing

In the preprocessing phase, information is collected to be used as input and output to the neural network. This data is normalized and calibrated; in other words, their fluctuations and disorders are reduced, or so-called, we change the data to be used as input to a neural network.

In the architecture phase, a type of neural network is modeled to describe the relationships between inputs to make meaningful outputs. Different neural network models and structures interpret, shape, and justify other data. The best neural network models are the ones that can be used for successful and efficient predictions. The sensitive analysis predicts the role of detecting practical values in a neural network.

Finally, in post-processing, different business strategies are used to predict the results, so that the neural network can have the best ability to predict.

Essential parameters for neural network modeling to predict health care costs are:

Output Variable:
Having or not having breast cancer

Input Variable:
Age - Weight - Age of onset of menstruation - Age of menopause - Duration of Birth control pills(OCP) use - Age of first pregnancy - Family history - Exercise - Number of breastfeeding months

The shape structure of the bilayer neural network can be considered as Figure (1) (Ranganat et al., 2014).

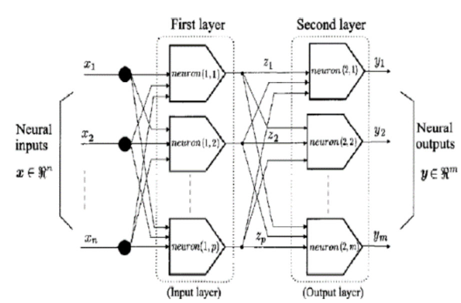

Fig. 1. Two-layer neural network (Ranganat et al., 2014)

And we have the separation of the first and second layer neurons as shown in Figure (2):

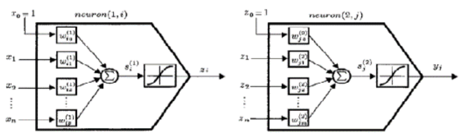

Fig. 2. Separation of first and second layer neurons (Wang et al., 2017)

The weights of the first and second layers of the two-layer neural network in vector form is as follow:

Relation (1) (input layer)

$$W^{(1)} = [W_1^{(1)}\ W_2^{(1)} \dots W_P^{(1)}]^T = \begin{bmatrix} w_{11}^{(1)} & \dots & w_{1n}^{(1)} \\ w_{21}^{(1)} & \dots & w_{2n}^{(1)} \\ w_{p1}^{(1)} & \dots & w_{pn}^{(1)} \end{bmatrix} \quad (1)$$

Relationship (2) (output lawyer)

$$W^{(1)} = [W_1^{(2)}\ W_2^{(2)} \dots W_P^{(2)}]^T = \begin{bmatrix} w_{11}^{(2)} & \dots & w_{1n}^{(2)} \\ w_{21}^{(2)} & \dots & w_{2n}^{(2)} \\ w_{p1}^{(2)} & \dots & w_{pn}^{(2)} \end{bmatrix} \quad (2)$$

The linear and non-linear output of each layer of the two-layer neural network is as follows:

Relation (3) (input layer)

$$neuron(1,i) \begin{cases} s_i^{(1)} = \sum_{k=0}^{n} w_{ik}^{(1)} x_k \\ z_i = \delta(s_i^{(1)}) \\ i = 1,2,\dots,p \end{cases} \quad (3)$$

Relation (4) (output layer)

$$neuron(1,i) \begin{cases} s_j^{(2)} = \sum_{k=0}^{n} w_{jq}^{(2)} z_q \\ y_j = \delta(s_j^{(2)}) \\ i = 1,2,\dots,m \end{cases} \quad (4)$$

The following equation can be used to calculate the number of weights of the artificial neural network model:

Number of neural network weights = number of bias weights + number of input weights + number of layers weights (Equation 5)

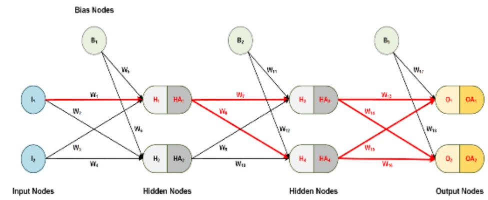

Fig. 3. Artificial neural network with 2 inputs and 2 hidden layers and Hernuron 2 and 2 outputs

The Levenberg-Marquardt algorithm is one of the most potent methods for training medium-sized multilayer neural networks (MLPs), a combination of descending gradient and Newton algorithms in classical optimization. This is why many Matlab software commands and features related to neural networks use this method to train MLP neural networks by default.

In the sampling method, using Cochran's formula, the number of samples was 384 people.

Cochran Formula:

$$n = \frac{\frac{z^2pq}{d^2}}{1 + \frac{1}{N}\left(\frac{z^2pq}{d^2} - 1\right)} \quad (5)$$

$$\frac{\frac{1.96^2 \times 0.5 \times 0.5}{0.05^2}}{1 + \frac{1}{1000000}\left(\frac{1.96^2 \times 0.5 \times 0.5}{0.05^2} - 1\right)} = 384 \quad (6)$$

In this formula, p and q are the success and failure ratios, which are considered 0.5.

The value of Z at the 0.05 error level is 1.96.

The value of error d is also considered 0.05.

The value of N represents the size of the target community.

The method chosen to formsulate the final research model is a multilayer neural network. This model is implemented in MATLAB software. To estimate the appropriateness of the prediction, various criteria such as mean square error (MSE) and root mean square error (RMSE) are used. These criteria can be represented as relationships 8 and 9.

$$MSE = \frac{\sum_{i=1}^{n} e_i^2}{n} \quad (7)$$

$$RMSE = \sqrt{\frac{\sum_{i=1}^{n} e_i^2}{n}} \quad (8)$$

In this relation, n is the number of predictions, and e_i is the prediction error, which is obtained from the difference between the predicted values and the actual values.

3. Analysis of Results

In this research, MATLAB software has been used to conduct the research method. MATLAB software allows the user to efficiently perform matrix, computational and functional operations easily, use different algorithms, and easily communicate with other programming languages. The In the pseudo-code of Figure 9, the method of calculating the mean squared for training data, the standard squared for test data, the norm squared for training data, and the root of the mean squared for test data are explained, respectively.

database was collected from 384 breast cancer patients of Shariati Hospital in Tehran to obtain the variables of age, weight, age of onset of menopause, age of menopause, duration of OCP(Birth control pills), age of first pregnancy, family history, sports activity, number of months of breastfeeding and Whether or not you have breast cancer. . An explanation of the classification of each of the research variables is shown in Table (1). Some of the database results are shown in Table (2).

Table 1. Classification of research variables

A little	Feature category	Property
1	Less than 30	Age
2	30-40	
3	40-50	
4	Above 50	
1	Less than 50	Weight
2	50-60	
3	60-70	
4	Above 70	
1	Under 12 years old	Age of onset of menstruation
2	12-16	
3	Over 16 years old	
1	Under 40 years	Menopausal age
2	40-50	
3	Over 50 years	
1	Under 20 months	Duration of OCP consumption
2	20-30	
3	Over 30 months	
1	Under 20 years	Age of first pregnancy
2	20-30	
3	30-40	
4	Over 40 years	
1	have	family history
0	does not have	
1	have	Sports activities
0	does not have	
1	Less than 24 months	Number of breastfeeding months
2	24-48	
3	Over 48 months	
1	have	Breast Cancer
0	does not have	

Table 2. is part of the collected database

Age	Weight	Age of onset of menstruation	Menopausal age	Duration of OCP consumption	Age of first pregnancy	family history	Sports activities	Number of breastfeeding months	Breast Cancer
4	4	2	2	3	4	1	0	1	1
4	4	1	3	3	3	1	1	3	0
1	3	3	1	1	3	0	1	3	1
4	2	1	3	3	4	1	1	1	0
3	3	1	2	3	1	0	1	3	0
1	1	3	1	2	4	0	1	1	0
2	4	2	2	2	2	0	1	1	1
3	4	2	3	1	1	1	0	1	1
4	4	3	3	3	3	1	0	2	0
4	2	3	1	1	1	0	1	2	1
1	3	3	1	2	1	0	0	1	1
4	1	1	3	3	3	1	0	1	1
4	2	3	2	3	2	0	0	1	1
2	2	2	1	2	2	1	1	3	0
4	1	2	2	1	2	1	0	3	0
1	1	1	1	2	2	0	1	2	0
2	2	3	3	3	2	0	1	2	1
4	1	2	2	3	3	1	0	2	0
4	3	2	2	2	1	1	0	2	1
4	2	3	3	1	1	1	0	1	0
	3	1	3	3	1	0	1	3	1
1	3	1	1	2	2	1	1	1	1
4	3	2	3	3	4	0	0	3	0
4	1	2	3	1	1	1	0	1	1
3	1	3	3	2	3	1	1	1	0
4	2	3	1	3	3	0	1	3	1
3	3	3	2	1	4	0	1	2	0
2	3	1	2	2	4	1	1	1	0
3	2	1	1	1	2	0	0	3	0
1	4	1	1	1	2	0	1	2	0
3	3	3	3	2	3	1	1	1	0
1	4	3	1	2	2	0	0	2	1
2	3	3	2	1	4	1	1	3	1
1	2	1	1	2	4	1	1	3	0
1	1	3	1	1	3	1	0	2	0
4	3	1	2	1	2	1	0	2	1
3	4	1	2	1	3	1	0	1	1
2	2	2	1	1	1	0	1	1	0
4	1	1	3	3	2	1	0	3	1
1	2	2	1	3	2	0	0	1	1
2	1	3	1	3	3	1	1	2	1
2	2	2	3	3	4	1	0	2	1
4	2	3	1	1	4	1	0	3	0
4	3	1	3	2	4	0	1	1	0
1	2	3	1	1	1	0	1	3	1

2	4	3	2	1	3	1	0	1	0
2	3	3	2	1	1	1	1	1	0
3	4	1	3	3	4	1	0	2	0
3	3	2	2	2	3	1	0	3	1
4	4	2	2	2	4	0	1	1	1
2	1	3	3	2	4	0	0	1	1
3	3	2	2	1	4	0	0	3	1
3	2	3	2	2	2	0	1	2	1
1	3	2	1	3	1	0	1	1	0
1	3	1	1	3	3	0	1	3	1
2	1	1	3	2	1	1	0	3	1
4	2	3	1	3	1	0	0	1	0
2	1	1	3	2	2	0	0	1	0
3	3	2	2	1	1	0	1	3	0
1	4	2	1	2	3	0	0	3	0
4	2	1	2	2	3	0	0	1	0
2	4	2	2	1	3	1	1	1	0
3	3	2	3	1	2	0	0	2	0
3	1	1	1	1	4	0	1	2	0
4	3	3	1	3	3	0	1	2	0
4	2	1	3	2	4	0	1	1	1
3	4	1	2	3	4	1	1	3	1
1	1	1	1	1	2	1	1	3	1
1	2	2	1	1	3	0	1	3	1
2	2	1	1	2	2	1	0	1	1
4	2	2	1	1	3	0	0	2	1
2	4	1	1	3	4	1	0	1	1
4	2	1	1	3	3	1	1	2	0
1	4	3	1	2	1	1	1	2	1
4	2	1	2	1	4	0	0	1	0
2	1	2	1	3	1	1	0	3	1
1	1	3	1	3	2	0	1	3	0
2	3	2	1	3	3	0	0	3	0
3	2	3	3	1	4	1	0	2	0
2	1	3	2	2	2	1	0	1	0
2	2	2	1	2	3	0	0	3	1
4	3	2	2	3	4	1	0	3	1
3	1	1	3	3	1	1	0	1	0
3	3	3	3	2	1	0	0	1	1
4	1	1	2	3	1	1	1	3	1
2	4	1	3	2	2	0	0	2	1
4	2	3	3	2	2	0	0	3	0
4	4	2	1	1	4	0	1	3	1
2	1	3	1	1	1	1	1	1	1
3	2	2	1	3	3	0	0	1	1
1	1	1	1	1	1	0	0	1	0
1	3	1	1	2	4	1	0	2	1
3	3	3	3	3	1	0	0	3	0
4	3	2	3	1	3	1	1	2	1
4	2	2	2	1	4	1	0	1	1
1	3	2	1	2	2	1	1	3	1
3	3	1	3	3	1	1	1	2	0
2	3	1	3	2	1	0	1	1	1
1	3	3	1	1	2	0	1	1	1

Essential parameters for early detection of breast cancer are:

- Age
- Weight
- Age of onset of menstruation
- Menopausal age
- Duration of OCP consumption
- Age of first pregnancy
- family history
- Sports activities
- Number of breastfeeding months
- Breast cancer

The first nine parameter is the input variable, and the tenth parameter is the output variable of the model. First, the input and output data are standardized using the Min-Max technique and converted to standard data in the range [+1, 0]. In relation (10) x_r, x_n, x_{max}, and x_{min} represent the actual, normalized, maximum, and minimum values of the data under study, respectively

$$x_n = \frac{2(x_r - x_{min})}{x_{max} - x_{min}} - 1 \ (10) \qquad (9)$$

Variables of age, weight, age of onset of menstruation, age of menopause, duration of OCP use, peiod of first pregnancy, family history, sports activity, number of months of breastfeeding as inputs, and variable of cancer or non-cancer as output in Predatory multilayer neural network was modeled using the Levenberg-Marquardt learning algorithm. Four hidden layers with neuron size 4 2 4 2 and 75 weights are considered to evaluate nine inputs and one output.

70% of the data are randomly selected for training and 30% for testing. The results of this neural network are shown in Figure 6 for data from the database and the output of the neural network model for predicting breast cancer. Figure 7 shows the number of repetitions on the one hand and the average squares of error in the marked green area on the other hand from the third repetition onwards without improvement, which has stopped the learning process.

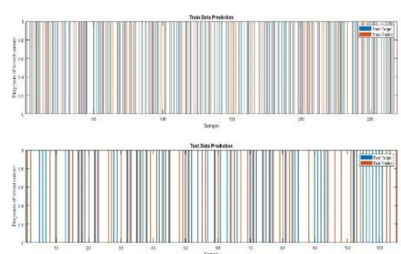

Fig. 8. Diagrams of trained and predicted data with multilayer neural network

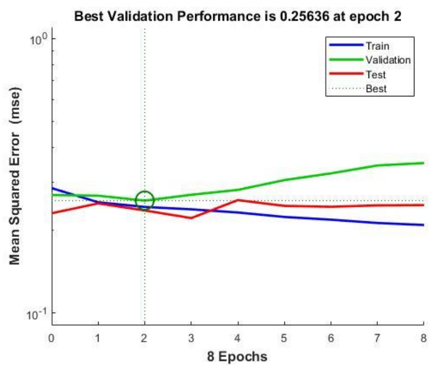

Fig. 9. Error squares diagram of multilayer neural network training and test data

Different factors in the diagnosis of breast cancer were determined by reviewing research in this field. Breast cancer diagnosis modeling was performed using a 4-layer neural network with several 4 2 4 2 neurons with the Levenberg-Marquardt post-diffusion training algorithm, the results of which indicate that the training has stopped after eight repetitions. The result shows that after two repetitions, the output did not improve, and the repetition did not continue. Figure (10) shows the weights obtained from neural network models. Also, according to Table (2), the error rate of the results obtained from the hybrid model of multilayer neural network is very appropriate.

The results indicate that selecting the proposed method for diagnosing breast cancer using a multilayer neural network is appropriate. To compare the results of the present study with other researches, the article of Abdulaziz et al. In 2019 entitled Machine learning model was used for predicting chronic kidney disease based on IoT and cloud computing in smart cities. The innovation of the present study is in comparison with the research of Abdulaziz et al., Which examines breast cancer by adopting an artificial neural network method to predict chronic kidney disease, which was selected in terms of importance and early detection of this disease. Also, the results of the present study in evaluating the artificial neural network model show that the error rate of the model is very desirable, and the size of the article by Abdulaziz et al.

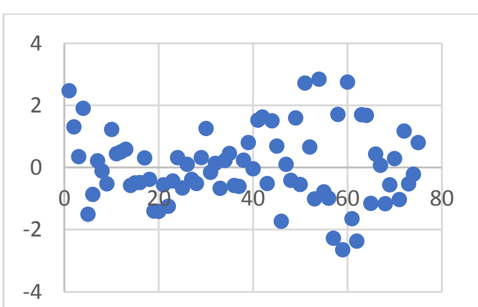

Fig. 10. Weights from the neural network

Table 3. Evaluation of model accuracy estimation by MSE and RMSE methods

		neural network
MSE	train error	0.3011
	test error	0.0783
RMSE	train error	0.5487
	test error	0.2798

To study the situation of IoT in smart cities, the diagnosis of breast cancer is analyzed and discussed. Due to the importance of personal information in the early diagnosis of breast cancer, the attractiveness of the IoT in smart cities can be used.

(1) More network distribution and consequently more access points to the system are challenges. Also, the objects that are supposed to be connected to the Internet usually have a more straightforward structure and architecture than computers, making it difficult to implement security tools in them. The last reason, and according to the author, the most important reason, is that the Internet of Things is much closer to real-life than the current Internet. Infiltrating such a network would be equivalent to injecting users' daily lives.

(2) The concept of privacy has always been used in conjunction with security, in this discussion, it is appropriate to pay special attention to it, because in the Internet of Things, more private information is placed on the network than in the current situation. Today, only 13% of Internet traffic is encrypted, but this figure is likely to increase in the future.

(3) Although the Internet of Things is ready to serve human beings and improve their living conditions, there are certainly threats to it, along with all the opportunities it has to make life easier. Keep an eye out for people other than yourself. It can be dangerous and raises the suspicion of a privacy breach.

(4) With the extension of the Internet of Things, many tools with traditional and cultural functions will give way to new tools,This unification will cause the geographical boundaries to disappear and cultures to be challenged in practice. On the other hand, high volumes of information cause anxiety and reduce anxiety. The solution for virtual literacy thinkers is to limit the use of the Internet.

It's been a long time that technology experts have predicted a world of billions of interconnected devices, the convergence of several factors has made the use of the Internet of Things a very upward and promising trend in recent years. Also, many of the hardware on which objects are built today are used, one of which is the RFID hardware infrastructure. RFID enables the automatic identification, tracking, and management of things, humans, and animals using radio frequency communication. RFID function depends on two tags and code readers that use radio waves to communicate.

RFID is called a set of technologies that uses radio waves to identify people and objects, and methods are used to identify people and things, store a person's serial number, or an object inside a microchip to which an antenna is attached is one of the methods of automatic detection. RFID systems and solutions based on this technology enable many day-to-day processes for industry owners with minimal error.

New technologies are constantly evolving and advancing. One of these emerging and applied technologies is intelligent urban systems using IoT technology. With IoT technology, objects and tools can be made brighter. The smart city system provides quality and affordable services to all to increase productivity and quality upgrades.As a new form of sustainable development, the concept of "smart urban IoT" has expanded greatly in recent years. This represents an urban model, pointing to all alternative methods for urban information management and processing to enhance the quality and performance of urban services for better interaction between citizens and government. To do this, data from free-walking patterns and data collected in the laboratory and clinical setting must be combined for an accelerometer-based assessment of the risk of falls. Wearable devices track steps performed, distance traveled the intensity of physical activity, and heart rate. Some even estimate repetitions during resistance training. Many programs offer training programs, including progressive resistance training and balance training. Wearables and applications may be prescribed for postmenopausal women to prevent sarcopenia. Another opportunity for middle-aged women would be to develop specific programs to calculate the daily amount of protein and other nutrients related to muscle and body health and prevent sarcopenia. Home and home provided. The intelligent clothing monitoring system can effectively measure skin temperature and relative humidity in different body areas for people. Information on the frequency, duration, and severity of flushing can be retrieved and physiologically quantified vasomotor symptoms. Sleep was measured using a FitbitVR tracker and a sleep diary . In contrast, sleep quality was measured using the Pittsburgh Sleep Quality Index and the Patient Outcome Information System (PROMIS), a short form of sleep disorder.

To examine each of the input variables by removing each of the variables and creating an artificial neural network with one input and one output, sensitivity analysis is performed on each variable. Sensitivity analysis was performed for each of the variables of age, weight, age of onset of menstruation, age of menopause, duration of OCP use, period of first pregnancy, family history, sports activity, and several months of breastfeeding, and the accuracy of each model is shown. The higher the MSE and RMSE of the model, the lower the importance of the variable for the model, which according to Table (4) can be more important than family history and less critical to the variables age, weight, age of onset of menstruation and number of months of breastfeeding Appeared.

Table 4. Investigation of accuracy estimation of models by MSE and RMSE methods

		Age	Weight	Age of onset of menstruation	Menopausal age	Duration of OCP consumption	Age of first pregnancy	family history	Sports activities	Number of breastfeeding months
MSE	train error	19.8104	59.0186	59.0186	14.2900	59.0186	19.2714	0.2379	0.595	59.0186
	test error	27.2696	27.2696	27.2696	3.8348	27.2696	5.4348	0.0348	0.4261	27.2696
RMSE	train error	4.4509	7.6824	7.6824	3.7802	7.6824	4.3899	0.4878	0.2439	7.6824
	test error	5.2220	5.2220	5.2220	1.9583	5.2220	2.3313	0.1865	0.6528	5.2220

Breast cancer diagnosis modeling was performed using a 4-layer neural network with some 4 2 4 2 neurons and the Levenberg-Marquardt post-diffusion training algorithm.

MSE and RMSE error for the proposed artificial neural network model in early detection of breast cancer was evaluated as follows:

		neural network
MSE	train error	0.3011
	test error	0.0873
RMSE	train error	0.5487
	test error	0.2798

4. Conclusion

This study examines the neural model in the diagnosis of breast cancer by modeling the secret Markov model with data on nine inputs: age, weight, age of onset of menopause, menopausal age, duration of OCP use, period of first pregnancy, family history, exercise and number of months of breastfeeding. The titles of the inputs and variables of breast cancer as the output of the feed neural network were determined by the Levenberg-Marquardt post-diffusion learning algorithm.The accuracy of the models was determined by MSE and RMSE methods. Sensitivity analysis also showed that family history was more important, and less important were the variables of age, weight, age of onset of menstruation, and a number of months of breastfeeding.

Given the importance of personal information in the early detection of breast cancer, the attractiveness of the Internet of Things in smart cities can be exploited. The traditional model of hospital care is more responsive and tends not to involve patients as an active part of the medical process. But the current system has shortcomings. First, physicians lack access to the patient's daily information about the patient's daily routine, such as physical activity, diet, sleep, and social life, which are important in diagnosis and treatment. Second, a patient's lack of adherence to medical treatment and counseling increases the risk of poor health outcomes, hospitalization, and increased economic burden on the individual and the health system. Third, large cities will demand more health care infrastructure to serve population growth. Lastly, as the demand for healthcare services increases, so makes the need for healthcare workers. Patient-centered care is the solution to the increasing demand for medical services worldwide. To truly integrate hospitals or clinics with patients in patient-centered care, there is a need to use a robust IoT ecosystem. Incorporating smart wearable sensors into routine patient care can enhance physician-patient relationships and increase patient engagement in their health care. However, wearables should only complement traditional methods of scoring mental, physical, and emotional health parameters. Nasal, preventive, personal, and participatory) medicine. Technology interconnection creates the need for more efficient and cheaper workflows, mobile health, and smart hospitals for better information sharing and fully informed data-driven decisions. Everyone's privacy must be respected, and strict measures are taken to ensure that national and international regulations regarding the protection of personal information are complied with.

To make better use of the Internet of Things and have a smart city, it is recommended that lifelong learning be implemented so that people of any age can use new technologies and community facilities. To increase creativity in the field of smart cities, it is suggested that the area of growing invention be created in citizens and turn creative ideas into products or services, and as a result, have active citizens.

Encourage citizens to participate more in urban affairs to to help implement the smart city project, help reduce the distance between citizens in terms of Internet access and communication tools, and create e-citizen training courses to make citizens more familiar. With IT concepts, it can alleviate the social challenges that exist in implementing a smart city for the early detection of breast cancer.

5. Offers

Personalization of medical applications, by increasing the patient's awareness of the doctor with the help of electronic communications such as mobile applications.

Lifelong IoT technology training should be implemented so that people of any age can use new technologies and community facilities.

The privacy of everyone is respected, and strict measures are taken to ensure compliance with national and international regulations regarding the protection of personal information, which recommends the use of blockchain technology.

The Bayesian Regularization algorithm can be used to improve the accuracy of a neural network with a limited or noisy, or complex database. Of course, this algorithm will be very time-consuming. Other meta-heuristic algorithms such as particle swarm algorithm (PSO) can achieve more accurate dimensions and better optimization. A combination of two meta-heuristic algorithms, such as GA-PSO or PSO-GA, can also be used.

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