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Diagnosis of Lumbar Intervertebral Disc Herniation and Pathological Characteristics Based on Artificial Intelligence Neural Network

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Abstract: In recent years, with the growth of life pressure and rhythm, the number of patients with lumbar disc herniation has been increasing rapidly, and the age of the affected population has been decreasing, which has had a great impact on people's daily work, study and life. This article aims to study the diagnosis of lumbar disc herniation based on artificial intelligence neural network. The diagnosis of lumbar disc herniation is mainly diagnosed by imaging, but there are errors in the accuracy of the diagnosis of lumbar disc herniation and the detection of special types of lumbar disc herniation. In this work, this paper proposes BP neural network and fuzzy neural network algorithms and studies these algorithms. Through algorithm improvement and neural network model construction, an intelligent medical diagnosis system is designed through the model, simulation experiments are carried out on the diagnosis of lumbar disc herniation, and the pathological characteristics of lumbar disc herniation are analyzed. The experimental results in this paper show that based on the improved artificial intelligence neural network algorithm in this paper, the diagnosis rate of lumbar disc herniation is close to 96.15%, with an average error of 0.06556. The intelligent medical diagnosis system designed in this paper forms the basis of system decision-making based on expert diagnosis history, can share expert experience, facilitate doctors to assist diagnosis or patient self-diagnosis, reduce expert expenses and save costs.

1. Introduction

Birth, old age, sickness and death are the laws of nature. Sickness is also a common phenomenon in people's lives. When the human body is sick, it will cause various direct or indirect symptoms. Different people have different symptoms, even if the same disease symptoms are different. At

present, the most commonly used diagnosis method in our country's medical treatment is based on the test results of various medical devices of patients. Doctors use their knowledge of pathology and years of experience to analyze and judge the condition and obtain diagnosis results. The accuracy of the diagnosis is closely related to the doctor's medical level, so this diagnosis method is greatly affected by subjective factors. There are many medical professionals in our country, but compared with large hospitals, the number of experts is very small. Especially in small and medium-sized areas and remote areas, there are problems such as uneven distribution of medical resources, which makes it difficult to see diseases in remote areas and lack of expert diagnosis. The misdiagnosis rate of various intractable diseases is very high, which brings a lot of pain and regret to patients and their families. Therefore, an intelligent diagnosis method is designed that can eliminate various human factors and obtain accurate and objective diagnosis results.

Lumbar disc herniation is the most common reason for lumbar spine surgery in people of working age. Patients with a family history of lumbar disc disease or with physically demanding work, or with a specific medical condition such as obesity, have an increased risk of lumbar disc herniation. How to diagnose lumbar disc herniation has become an important prerequisite for the treatment of lumbar disc herniation. Al-Sharaa M believes that clinical examination is one of the most suitable methods for diagnosing low back pain. Back pain is a disease in which symptoms, clinical findings, and imaging findings are not always related. Straight leg elevation (SLR) and sagging tests can be used to diagnose lumbar disc herniation [1]. Chen believes that a more comprehensive understanding of lumbar intervertebral disc herniation is essential. In treatment, the pan-long needling method combined with flying needles can regulate the meridians and regulate the mind; acupoint injection can transfer the medicine to the acupoints; the traditional Chinese medicine decoction can eliminate the evil and solidify the root; balance cupping combined with exercise therapy can regulate the tendons and prevent recurrence. The principle of combination of acupuncture and medicine can organically combine the advantages of different therapies, thereby enhancing or supplementing their curative effects. This method has achieved excellent results in clinical treatment [2]. Symptomatic lumbar disc herniation (LDH) is rare in children and adolescents. To date, there has not been a comprehensive review of the treatments available for LDH in children and adolescents and the effectiveness of each treatment. Mustafa believes in reporting the cause, family history, symptoms, prominence, duration of symptoms, imaging findings, and treatment methods and results. Use magnetic resonance imaging (MRI) to confirm lumbar disc herniation [3]. Colorimetric probes based on multi-walled carbon nanotubes (MWNT) are designed to detect and monitor the levels of apolipoprotein-L1 (ApoL1) in patients with lumbar disc herniation (LDH). ApoL1 is easily found in human serum in the LDH group, but not significantly expressed in the normal control group (Ctrl), spondylolisthesis (SSP) group, spinal fracture (SFR) group and scoliosis (SSC) group. The MWNT-based probe prepared by Huang Y is also used to track the recovery of successful LDH patients. The P values of the proposed method and the conventional enzyme-linked immunosorbent assay (ELISA) for early diagnosis and recovery monitoring were 0.05 respectively, indicating that this detection strategy is significantly different from the traditional ELISA. All experimental results indicate that ApoL1 may be a potential biomarker for early diagnosis of LDH [4]. Intelligent diagnosis can quickly and effectively process the collected signals to provide accurate diagnosis results. It is a very promising tool for big data processing. Traditional intelligent diagnosis methods are based on prior knowledge and diagnosis knowledge to manually extract features. Such a process utilizes human ingenuity, but it is time-consuming and laborious. Inspired by the idea of unsupervised feature learning using artificial intelligence technology to learn features from raw data, Lei Y proposed a two-step learning method for diagnosing mechanical intelligence. In the first stage of method learning, sparse filtering is an unmanned two-level neural network used to learn features directly from mechanical vibration

signals. The second step uses softmax regression to classify the health status according to known features [5]. This method is verified by massive mechanical data in various situations [6]. Uncertainty natural language processing has always been a research hotspot in the field of artificial intelligence. Yang L applies it to intelligent diagnosis of diseases by constructing an intelligent model that directly processes natural language. The theoretical basis of this model is classical concept lattice and natural language lattice implication algebra, including the case database formed by patients, attribute matching, and the calculation of the matching degree of new patients. According to the characteristics of patients, the disease attributes are first divided into intrinsic invariant attributes and extrinsic variable attributes. The calculation algorithm of the linguistic truth-value formal concept and the construction algorithm of the linguistic truth-value concept lattice based on external attributes are proposed. And the disease basis of different treatments was established for different patients with the same disease [7].

The innovation of this article is to improve the BP neural network algorithm and the fuzzy neural network algorithm to deal with various complex problems in diagnosis, treatment and diagnosis. The important attributes of the data after the reduction of the decision table are extracted as the training samples of the neural network, and then the trained samples are used. The neural network system diagnoses various other uncertain situations, which not only improves the efficiency of the system, but also enhances the fault tolerance.

2. Related Algorithms

2.1. Lumbar Disc Herniation

Lumbar disc herniation (LDH) refers to the degeneration of the annulus fibrosus under axial pressure. The nucleus pulposus material protrudes posteriorly through the torn fibrous annulus, pulling and stimulating the nerve endings, spinal nerve roots or cauda equina deep in the ligament, causing symptoms characterized by low back pain and sciatic nerve radiating pain [8]. There is no record of the exact disease name of “lumbar intervertebral disc herniation” in ancient Chinese medicine books. According to the clinical symptoms, there are disease names such as “back pain”, “legs and thigh wind”, “sit buttocks wind”, etc., which belong to “Bizheng” [9]. At present, the pain mechanism of LDH mainly includes mechanical compression mechanism, inflammatory chemical stimulation, and immune response of the body [10]. With the development of society and econoour, with changes in the nature of work, lifestyle, and entertainment, maintaining the same posture for a long time causes the muscles of the lower back and back to be in a state of stress and tension for a long time, so that the stress of the intervertebral disc is increased, which can easily lead to the nucleus pulposus outstanding, the incidence rate is increasing year by year. According to LDH epidemiological studies, the 25-55 age group has the highest incidence rate in the survey area, and the top three occupational groups with the incidence rate are, in order, long-term heavy-bearing manual workers, sedentary vehicle drivers, Long-term desk worker[11]. LDH is one of the common clinical diseases and frequently-occurring diseases. It is the main clinical feature of recurrent lumbar pain, difficulty walking or intermittent claudication [12-13]. Because of its recurring characteristics, it has a serious impact on the lives of most patients, mainly including physical function, physical pain, life vitality, mental health, social function, etc.[14-15]. To a certain extent, it brings heavy economic burdens to individuals, families, and society.

2.2. Routine Diagnosis Methods of Lumbar Disc Herniation

Lumbar disc herniation is currently the most common clinical disease in orthopedics, and there are still difficulties in clinical diagnosis, but with the development of imaging, especially CT

(Computerized tomography) and MRI (Resonance Imaging) [16-17], clinicians have a further objective understanding of lumbar disc herniation and improved the accuracy of the diagnosis of lumbar disc herniation [18]. As we all know, normal intervertebral disc is composed of cartilage endplate, annulus fibrosus and nucleus pulposus [19]. At present, degenerative disc disease is one of the most recognized reasons for lumbar disc herniation [20-21]. Figure 1 shows the routine diagnosis of lumbar disc herniation.

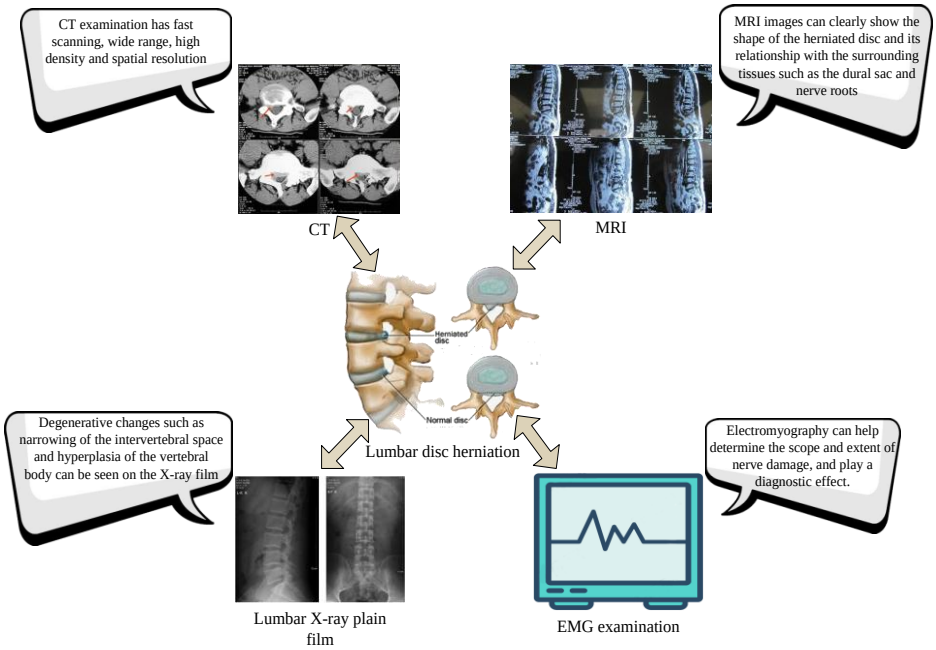

Figure 1. Diagnosis of lumbar disc herniation

Diagnosis is often based on the experience of experts, without specific rules, and is greatly affected by subjective factors. Experts themselves often cannot describe how they came to the diagnosis, various symptoms and various diseases. There is no linear relationship that can be accurately expressed in mathematical form. In other words, there is a nonlinear mapping between various symptoms and their diagnostic results, which is difficult to automate and formalize. This shows that even if a large number of experiments are done, it may not be possible to achieve the desired result. Diagnosis results based on probability or statistical calculations often get contradictory results or large errors in medical diagnosis applications. After a lot of practical analysis, it is found that a good diagnosis system must have the experience of experts themselves. Relatively accurate judgment, how to popularize the experience of experts and use it as a reference for others' diagnosis are particularly important, and it has become a main research direction of medical diagnosis.

2.3. Artificial Intelligence Neural Network Algorithm

Neurons control the transmission of information to the human brain and respond to external stimuli. These tens of billions are due to the close connections between neurons. A neuron is often connected with thousands of neurons to become the neural network of the human brain [22- 23]. Neurons are transmitted to neighboring neurons to accumulate stimuli, creating their own stimuli to a certain extent, and transmitting them to neighboring neurons. These large numbers of neurons are the response of the human brain to external stimuli [24]. Artificial neural networks have strong learning and nonlinear mapping capabilities, and have relevance, generalization, analogy and ease

of use. Because of its incomprehensible rules and complex mechanism, it has been widely used in medical diagnosis. Artificial neural network is based on computational model and mathematical model of biological neural network. It consists of a series of interconnected artificial neurons that use links to send calculation information. Artificial neural network consists of three parts: input, hidden layer and output plane [25]. The output layer corresponds to a single attribute, and the network output layer contains the solution to the problem. The hidden layer is located between the input and output layers and is heavy. The weight represents the relative strength of the input data. Multiply each input value by the weight and sum the value of the weighted sum A. The formula for n inputs is:

$$A = \sum_{i=1}^{n} B_i \lambda_i \tag{1}$$

The j neurons in the layer with the formula:

$$A_j = \sum_{i=1}^{n} B_i \lambda_{ij} \tag{2}$$

$$A_w = 1/\left(1+t^{-A}\right) \tag{3}$$

Where aaaaaaa is the normalized value of A. The threshold is the barrier value for the neuron's output to trigger the next level of neuron. If the output value is less than the threshold, it will not be passed to the next level of neuron.

2.4. BP Neural Network Algorithm Model

As an intelligent algorithm, BP neural network has been widely used in practice in recent years. In medical diagnosis, knowledge is relatively fuzzy, it is difficult to express and extract information, and knowledge acquisition is relatively difficult. However, because neural network has the basic characteristics of human brain, it can learn from the external environment and realize large-scale processing ability. Therefore, it is feasible to use neural network in medical diagnosis. In recent years, neural network has been successfully applied in clinical disease screening, diagnosis and prediction.

BP neural networks are the most widely used neural networks with clear principles and simple structure. However, there are many parameters of BP neural network model, and these parameters have a great impact on the operation speed, error and accuracy of the model. The study of the setting rules of BP neural network parameters can provide reference for the construction of superior models based on lumbar disc herniation with BP neural network.

The steps of the BP learning algorithm are as follows:

1) Immediately select x inputs and the corresponding desired output. The selected number is set according to the user's needs, generally accounting for 60% of the total number.

2) Randomly select the S-th input sample and the corresponding expected output:

$$r(x) = (r_1(x), r_2(x), ..., r_n(x)); w(x) = (w_1(x), w_2(x), ..., w_n(x)) \tag{4}$$

3) calculates the input and outputs of the implied layer:

$$si_a = \sum_{i=1}^{n} g_s r_i(x) - a_s, ..., a = 1,2,..., n \tag{5}$$

$$ti_b(x)=\sum_{t=1}^{m} g_t d_i(x)-b_t; b=1,2,...,m \tag{6}$$

4) Hidden input and outputs of units and actual input and outputs in the connection weights and valve calculations:

$$\frac{\phi ti_b(x)}{\phi si_a}=\frac{\phi\left(\sum_{s}^{n} g_{si}s(x)-a_s\right)}{\phi g_{si}}=si_s(x) \tag{7}$$

$$\frac{\phi e}{\phi ti_b}=\frac{\phi\left(\frac{1}{2}\sum_{t}^{m}\left(w_t(x)-s_a(x)\right)\right)^2}{\phi ti_b} \tag{8}$$

5) Seeks the partial derivatives of the neurons in the implicit layer:

$$\frac{\phi e}{\phi g_{si}}=\frac{\phi e}{\phi ti_b}\frac{\phi yi_b}{\phi g_{si}}=\varphi_0(x)si_a(x) \tag{9}$$

$$\frac{\phi si_s(x)}{\phi g_{is}}=\frac{\phi\left(\sum_{i=1}^{n} g_{is}r_i(x)-s_a\right)}{\phi g_{is}}=r_i(x) \tag{10}$$

$$\frac{\phi e}{\phi ti_s(x)}=\frac{\phi\left(\frac{1}{2}\sum_{t}^{m}\left(w_i(x)-ti_i(x)\right)^2\right)}{\phi ti_s(x)}\frac{\phi si_i(x)}{\phi ti_s(x)} \tag{11}$$

6) Connect Rights:

$$\omega g_{si}(x)=-\gamma\varepsilon_0(x)s_{is}(x) \tag{12}$$

$$G_{si}^{n+1}=g_{si}^{n}+\lambda\varepsilon_0(x)si_s(x) \tag{13}$$

7) Correct connection weights using partial derivatives of neurons of the implied layer and input of neurons of the input layer:

$$\omega g_{is}(x)=-\gamma\frac{\phi e}{\phi g_{is}}=-\gamma\frac{\phi e}{\phi si_s(x)}\frac{\phi si_s(x)}{\phi g_{is}}=\varepsilon_s(x)r_i(x) \tag{14}$$

$$G_{is}^{n+1}=G_{is}^{n}+\lambda\varepsilon_s(x)r_i(x) \tag{15}$$

8) Calculate the global deviation

$$E=\frac{1}{2mn}\sum_{x=1}^{m}\sum_{i=1}^{n}\left(w_i(x)-t_i(x)\right)^2 \tag{16}$$

9) In the above learning step, according to the step8 global error value, it determines whether the global error meets the expected error, and determines whether to reach the maximum number of learning times. If any one is satisfied, the algorithm is terminated, otherwise the step4 enters the

next cycle.

(1) Advantages and disadvantages of the BP network

The advantage is that BP networks network has powerful mapping functions from input to output and can provide an effective method for modeling problems with complex internal mechanisms. BP networks obtain reasonable mapping laws by learning training samples and have learning capabilities. Neural networks in input data and mode recognition, with the advantages of rigorous structure, strong operability, and clear thinking, can approximate any continuity function with any accuracy, and therefore are widely used in many domains.

The disadvantage is that the BP algorithm learning speed is very slow, from the mathematical way, BP network parameter adjustment range and the network error function partial derivative, near 0 or 1, the flat area of the error function, the deviation derivative is small each parameter adjustment is very small, making the training almost pause to slow learning speed, mainly determined by experience and experimental comparison. The new samples will affect the learned samples.

2.5. Fuzzy Neural Network

Artificial neural networks have many advantages, but they also have irreparable flaws. For example, there are considerable limitations in processing fuzzy information, and the learning process is easy to fall into local minimum; each neurons and power in the network cannot give clear physical significance, so that existing knowledge cannot be fully utilized to improve the structure and learning speed of the network and avoid the neural network into local minimum. Fuzzy neural network and fuzzy system belong to artificial intelligence technology, which have advantages and disadvantages that each other does not have, and have complementarity.

T-S fuzzy nervous system principle

The T-S fuzzy neural network is a highly adaptive fuzzy system that can not only automatically update, but also constantly corrects the membership functions of the fuzzy subsets. The learning algorithm of the fuzzy neural network is as follows:

(1) Error calculation

$$e = \frac{1}{2}(k_d - k_c)^2 \tag{17}$$

(2) Coefficient modification

$$d_j^i(k) = d_j^i(k-1) - a\frac{\partial e}{\partial d_j^i} \tag{18}$$

$$\frac{\partial e}{\partial d_j^i} = (k_d - k_c)p^i / \sum_{i=1}^{n} p^i x_j \tag{19}$$

(3) Parameter correction

$$c_j^i(k) = c_j^i(k-1) - \delta\frac{\partial e}{\partial c_j^i} \tag{19}$$

$$w_j^i(k) = w_j^i(k-1) - \delta\frac{\partial e}{\partial w_j^i} \tag{20}$$

Where c_j^i and w_j^i are the center and width of the membership function, respectively.

Like other intelligent algorithms, the initial population is created almost randomly before the start of optimization. The initial population of the fuzzy neural network intelligent algorithm is related to the convergence speed of the algorithm and the quality of the solution. If a differential initial population can be created, the convergence speed of the algorithm can be significantly improved, and the ability of the optimization algorithm can be enhanced. However, the original population randomly generated by the fuzzy neural network algorithm cannot guarantee the uniform distribution of individuals in the space, as shown in Figure 2. Therefore, this article uses a good set of point theories to create the initial solution. Good point theory is a good experimental method. For example, if you get the search points of the same point, then the appropriate point sequence will be more uniform than the points selected in other ways, as shown in Figure 3. This is very important for repetitive algorithms. If the optimal solution is within the selected starting point, the algorithm will quickly converge. If the selected starting point is far from the optimal solution, increase the number of iterations of the algorithm to ensure that the local optimality of the algorithm fails.

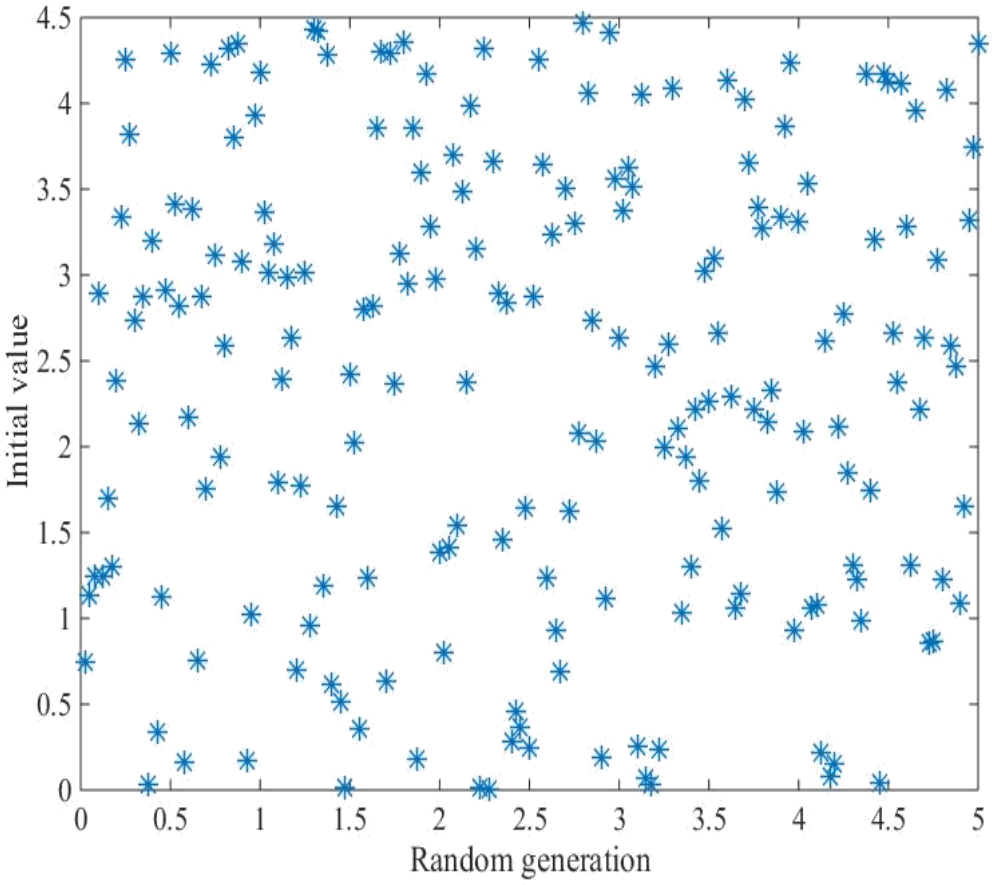

Figure 2. Randomly generated initial solution

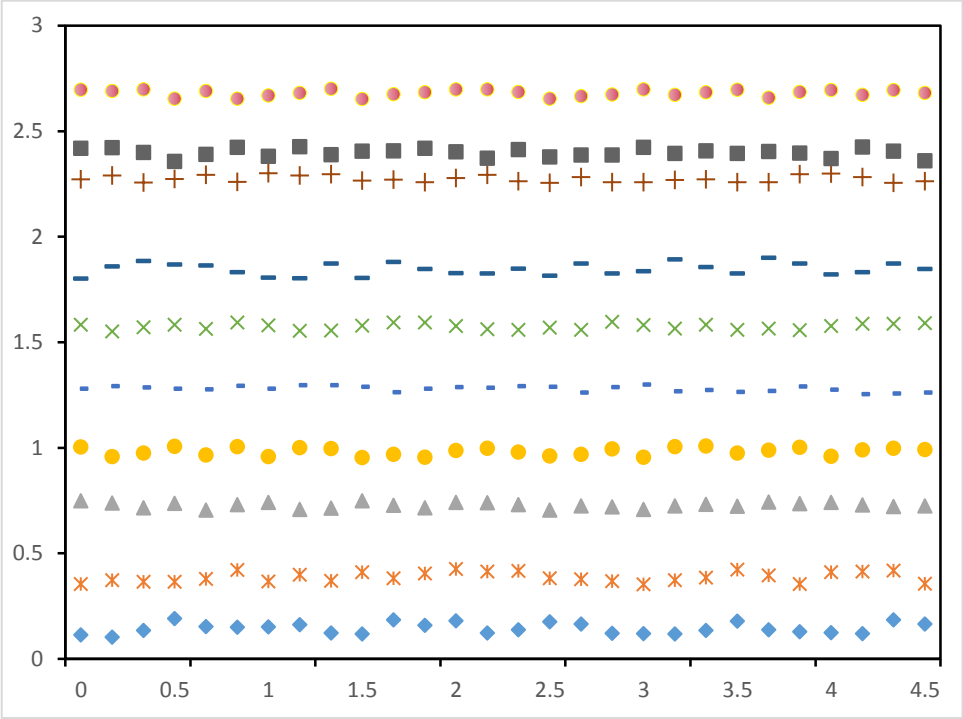

Figure 3. The initial solution produced by the good point set theory

3. Model Construction of the Diagnosis Method of Lumbar Disc Herniation Based on Bp Neural Network

3.1. Processing of Sample Data

The extracted feature data is preprocessed by the normalization method, and the feature data is transformed into the interval between -1 and 1. Lumbar disc herniation and non-lumber disc herniation are respectively regarded as the expectations of the BP neural network output, represented by 0 and 1 respectively.

If the output value predicted by the network is less than or equal to 0.5, it is considered to be non-lumbar disc herniation, otherwise it is considered to be lumbar disc herniation.

3.2. Model Topology

(1) Topological structure of the BP neural networks

The topological structure of the BP neural network consists of an input layer, a hidden layer, and an output layer. For the BP neural network-based lumbar disc herniation diagnosis method model, the detailed BP neural network structure diagram is shown in Figure 4:

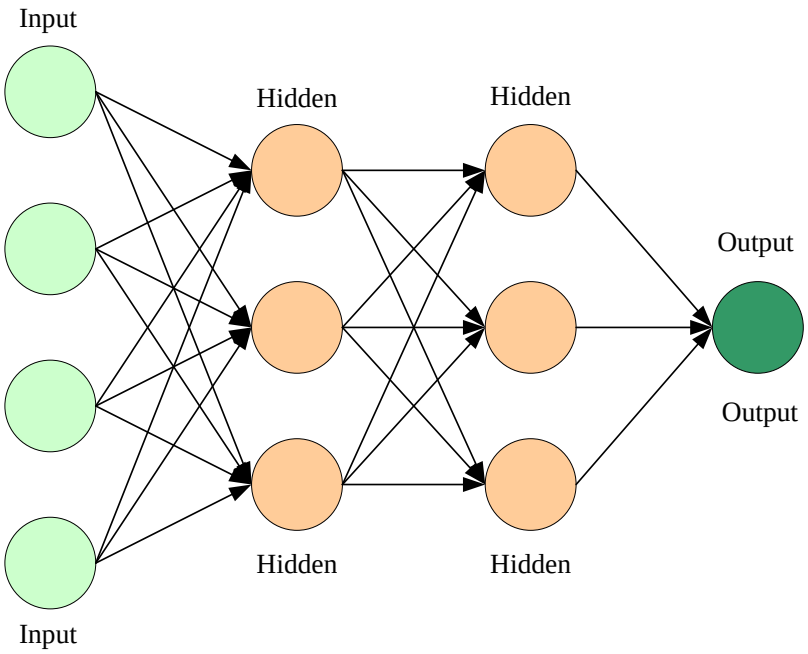

Figure 4. BP neural network structure diagram

(1) Topological structure of fuzzy neural network

The topological mechanism of fuzzy neural network is composed of input layer, fuzzification layer, fuzzy rule layer, anti fuzzification layer and output layer. The network structure diagram of lumbar disc herniation diagnosis method model of fuzzy neural network is shown in Figure 5:

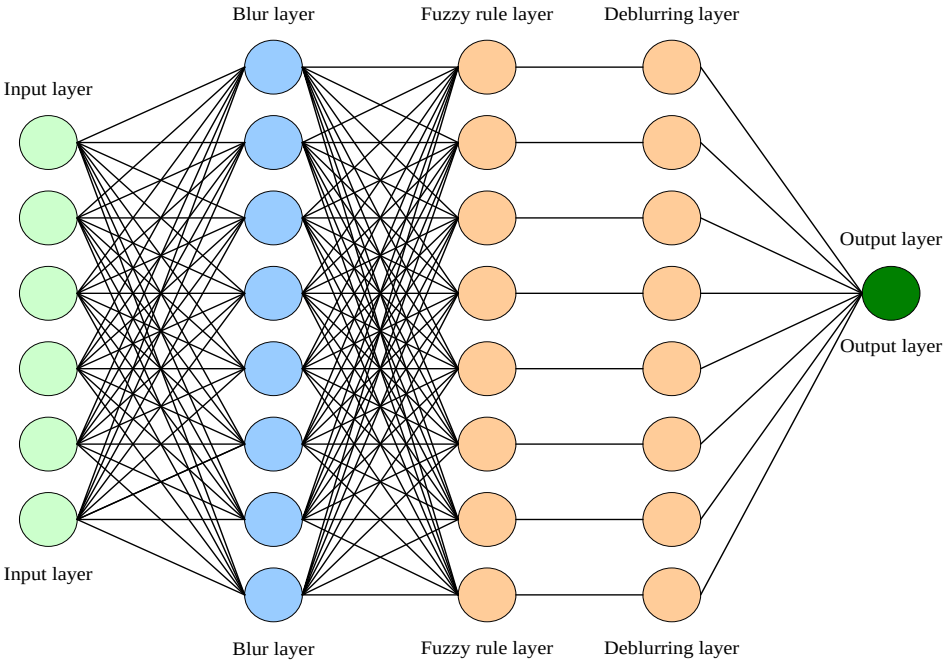

Figure 5. Fuzzy neural network structure diagram

3.3. Important Parameters of the Model

In the BP neural network toolbox, use the new-ff function to create a BP neural network. In this

function, the number of hidden nodes, node transfer function, training function, error margin, learning rate and other parameters have a significant impact on the performance of the BP neural network. Next is to pre-adjust the BP neural network training function, node transfer function, error limit, learning rate and other parameters, as shown in Table 1.

Table 1. Model parameter configuration of the diagnosis method of lumbar intervertebral disc herniation based on BP neural network

Number of input layer nodes	20
Hidden layers	1
Hidden layer nodes	6
Number of output layer nodes	1
Learning rate	0.1
Margin of error	0.01
Number of iterations	10000
Hidden layer node transfer function	tansig
Output layer node transfer function	purelin
Training function	trainlm

Suppose the expected output of the training sample of the diagnostic model of lumbar disc herniation based on neural network BP is 0 and 1, respectively, and the error limit is set to 0.01. The determination of learning rate has a significant impact on the stability of online learning, with very high learning rate, and very high weight adjustment. The learning rate is too small. Although the network can converge and achieve the desired network performance, it will greatly increase the network learning time, so in order to achieve the necessity of network convergence, biased to take smaller values, the learning rate is initially set to 0.1.

3.4. Simulation Experiment

Regardless of whether it is domestic or foreign, the current medical diagnosis system mainly has the following problems: first, the number of decision-making rules for diagnosis is too small to express the experience of most experts, and too many rules can easily cause the explosion of rule combinations and reduce the problem. Diagnosis efficiency, and the system developer has not considered the knowledge update problem and the changes in people's living habits and eating habits; second, the decision-making rules are more complicated, making it difficult for some experts to understand, causing communication barriers to the establishment of the knowledge rule base, and third, there are many types of diseases. The symptoms of various diseases are overlapped, the misdiagnosis rate is high, and the practicability is poor. How to choose the right algorithm is the key to solving the above problems. The content of the algorithm mainly includes how to express the symptoms of the patient, how to reason about the diagnosis process, how to match the symptoms and the diagnosis results, how to manage the database, etc. Solving the above series of problems can produce intelligence medical diagnostic system.

(1) Experimental subjects

This article is based on artificial intelligence neural network to diagnose lumbar intervertebral disc herniation. The total number of experimental samples is 52 cases, including 38 patients with lumbar disc herniation, 14 healthy subjects, medical records of patients with lumbar disc herniation and healthy subjects and laboratory test results, including: hospitalization number, name, gender, age, height, weight, blood pressure value measured for the first time at admission, BMI and other parameters, as well as previous hypertension, diabetes and other diseases. Combining the X-ray data,

CT data, MRI data and clinical characteristics of the examination with the expert database, the diagnosis experiment and pathological characteristics analysis of patients with lumbar intervertebral disc herniation are carried out.

(2) Experimental design

The intelligent medical diagnosis system designed in this paper is used as the front-end processing tool of BP network. Although neural network has been widely used in many fields, there are many problems in how to build an excellent neural network in application, which need to be continuously debugged, improved and improved. In addition to the improvement of the algorithm itself, we also need to consider the selection of parameters and functions of the hidden layer.

The diagnosis algorithm process is shown in Figure 6 for the medical diagnosis system architecture combined with artificial intelligence neural network algorithms.

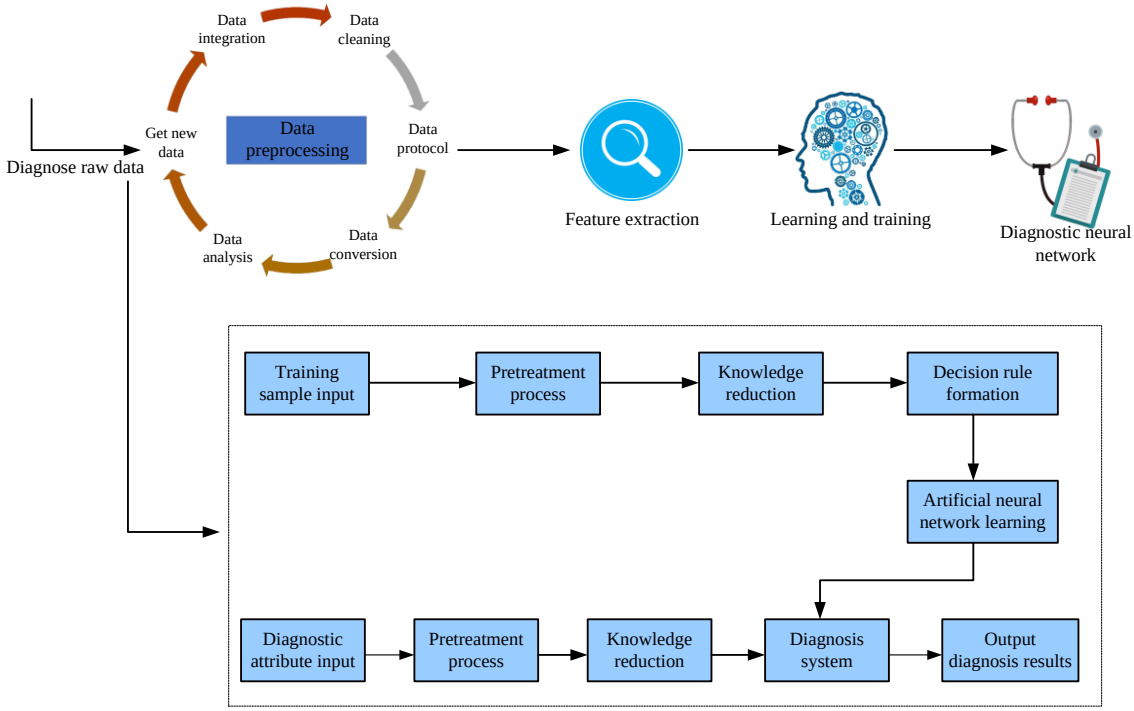

Figure 6. Medical diagnosis system architecture combined with artificial intelligence neural network algorithms

In the entire system, for the BP neural network algorithm model and the fuzzy neural network model, the training samples are first input into the diagnosis system. The diagnosis system first preprocesses and simplifies the training samples, and at the same time the neural network updates its learning and memory, for each training sample set for learning. For learning without a tutor, the training samples are sent to the self-organizing neural network for learning. Through clustering and division, according to the reasoning process of the decision table rules, a network that can realize diagnosis is trained.

(3) Data collection

For the analysis of pathological characteristics of lumbar disc herniation, in this paper, the measured data are expressed as mean π standard deviation (x±), and the numerical data are expressed as component ratio. Mann Whitney U test or x2 test are used for inter group comparison, and Pearson method is used for correlation analysis. The calculation and statistics were completed by SPSS 22.0 software. The test level a was set as 0.05 on both sides, $P < 0.05$, indicating that the difference was statistically significant.

4. Application Analysis of Diagnosis of Lumbar Disc Herniation and Pathological Characteristics Based on Artificial Intelligence Neural Network

4.1. Performance Analysis of Artificial Intelligence Neural Network Model

Perform simulation experiments on the performance of the standard BP neural network model to establish a good diagnostic model model for lumbar disc herniation based on the BP neural network. Use the sim function to verify its network performance through simulation. Among them, the expected output value of the network takes 0 or 1. If the predicted output value of the network is greater than or equal to 0.5, it is converted to 1, otherwise it is converted to 0, where 0 represents non-lumbar disc herniation and 1 represents lumbar disc herniation. Through five simulation experiments, record the number of iterations, average error, and accuracy, and take the average value to complete the evaluation of the model network performance as shown in Figure 7.

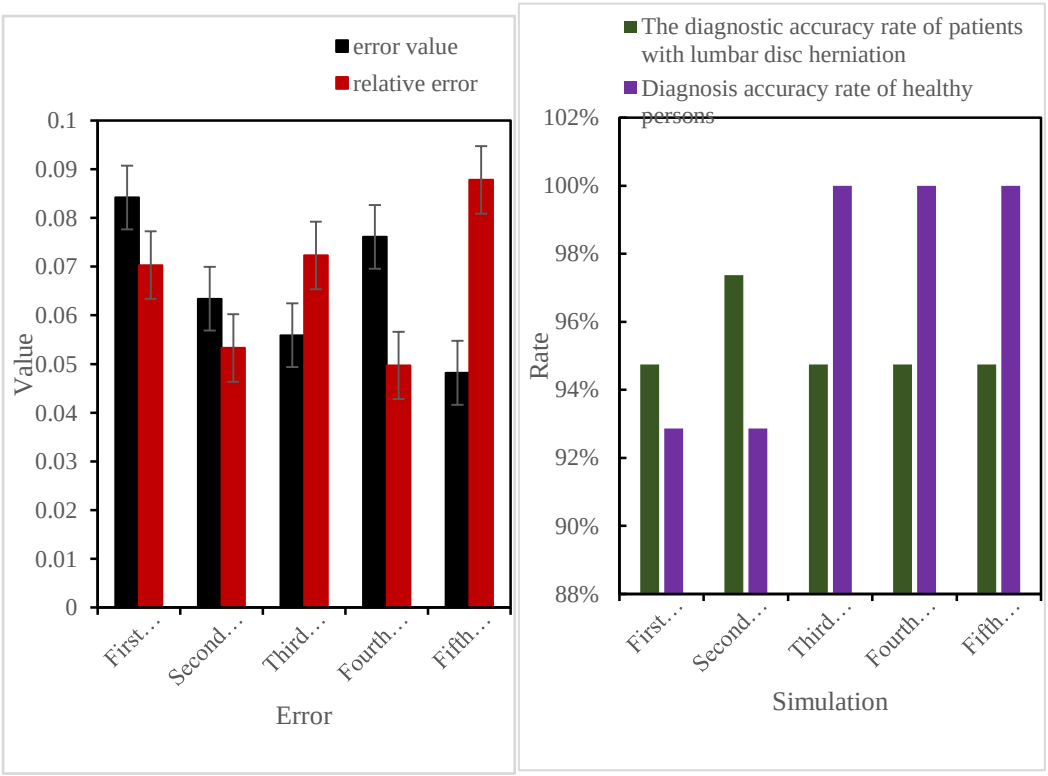

Figure 7. Performance diagram of BP neural network

In this prediction, the total number of test samples is 52 cases, including 38 cases of lumbar disc herniation, 14 cases of non-lumber disc herniation, of which 38 cases of lumbar disc herniation were diagnosed, 2 cases were misdiagnosed, and the diagnosis rate was 94.73%. The diagnosis was confirmed by healthy people. There were 14 cases, 0 cases were misdiagnosed, and the diagnosis rate was 100%. A total of 49 cases were diagnosed and 2 cases were misdiagnosed. The total diagnosis rate was 96.15%, with an average error of 0.06556.

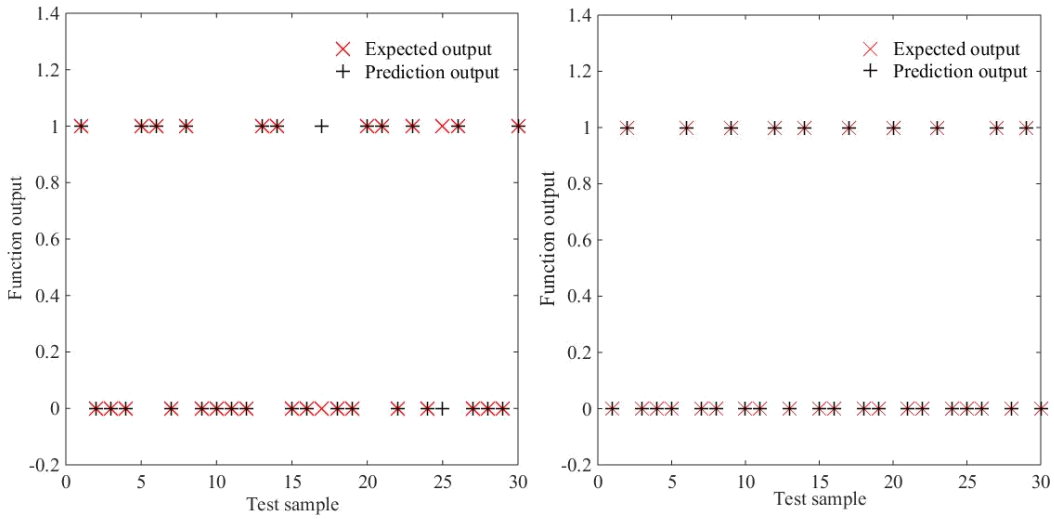

Figure 8. Forecast results of BP neural network and fuzzy neural network model

Figure 8 is the BP neural network prediction result diagram and the fuzzy neural network prediction result diagram. You can see the similarities and differences between the expected output and the predicted output of each test sample, and it can be seen that the predicted output of the fuzzy neural network is basically the same as the expected output.

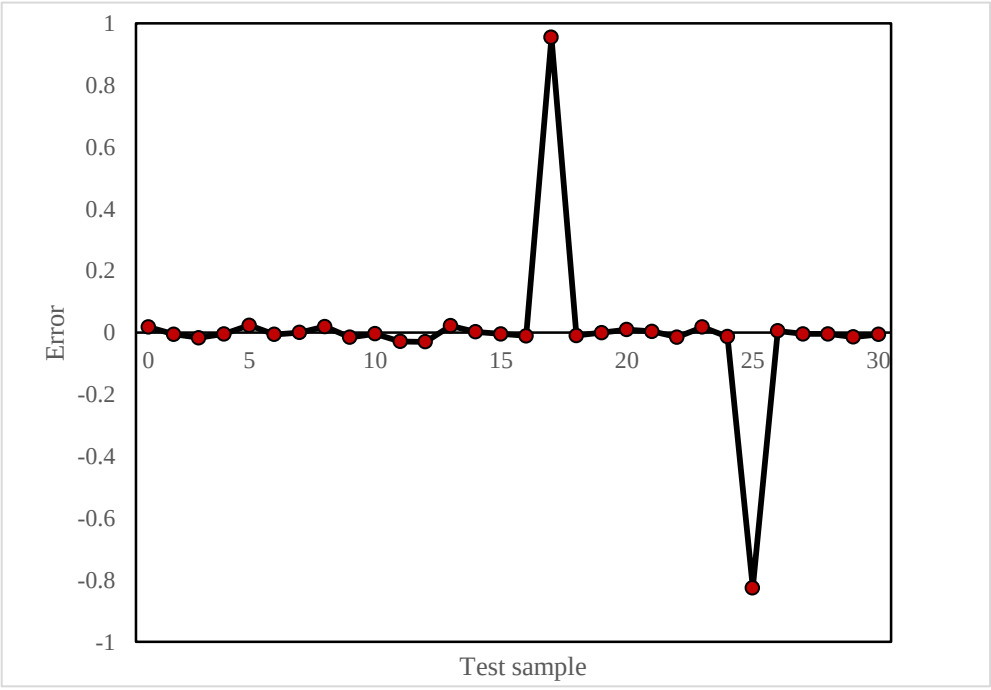

Figure 9. BP network prediction error

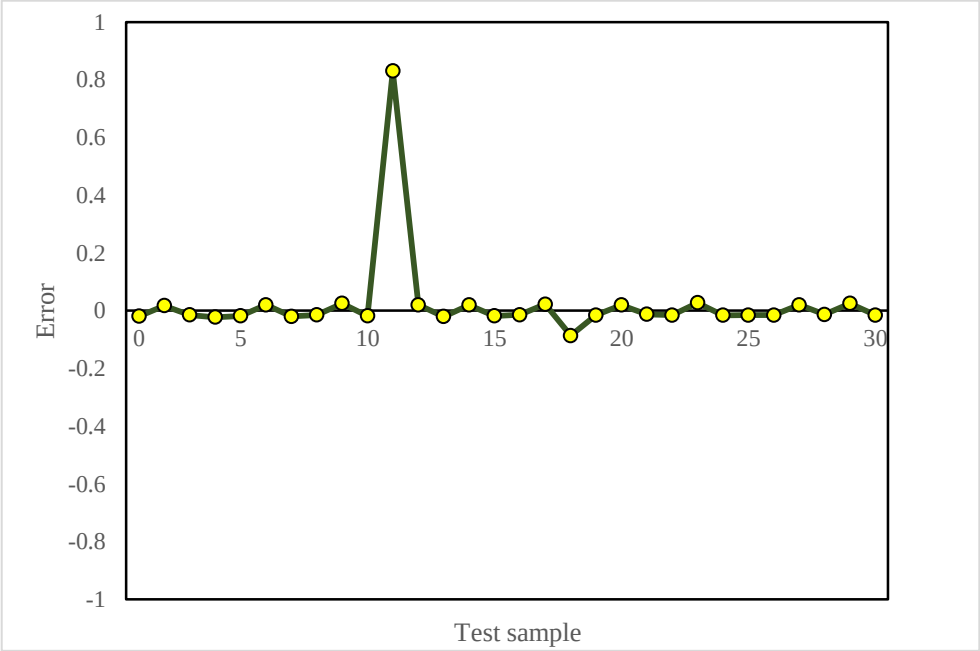

Figure 10. Fuzzy network model prediction error

Figure 9 and Figure 10 are the prediction error diagram of the BP neural network model and the prediction error diagram of the fuzzy neural network model. From the figure, you can see the error value between the expected output and the predicted output of each test sample, the fuzzy neural network model. The error value of is obviously smaller than the BP neural network model.

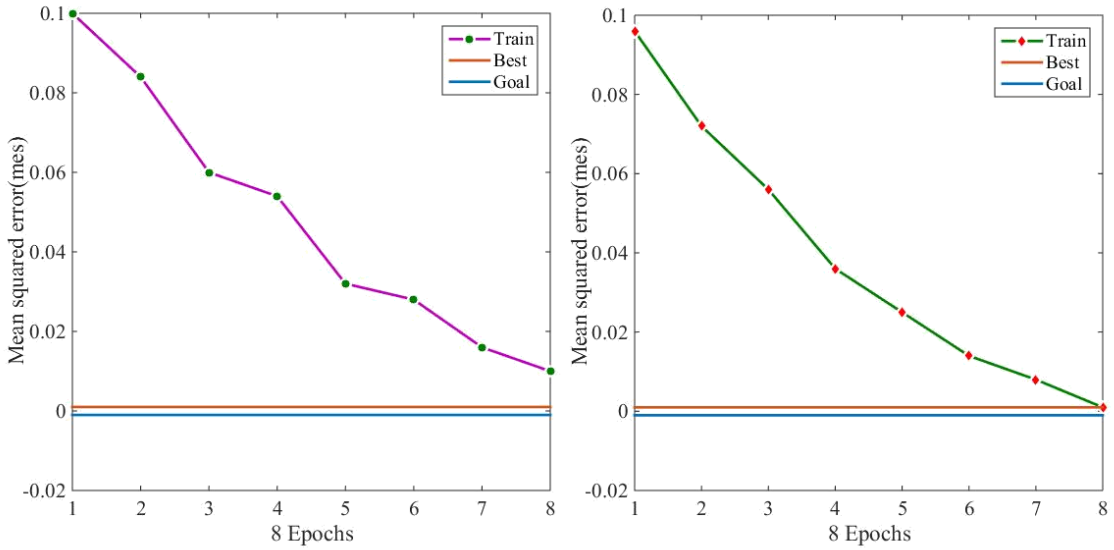

Figure 11. Convergence graph of mean square error of BP neural network model and fuzzy neural network model

The convergence rate of the BP neural network model and the fuzzy neural network model are shown in Figure 11. The diagnosis of lumbar disc herniation is better by using a fuzzy neural network model than by using a BP neural network.

4.2. The Pathological Characteristics of the Lumbar Intervertebral Disc Herniation Based on the Artificial Intelligence Neural Network Algorithm

Patients with lumbar disc herniation and health examinations are compared, as shown in Table 2.

Table 2. Comparison of general data between patients with lumbar disc herniation and healthy people

Group	Observation group	Control group	
Mean ± standard deviation	Mean ± standard deviation	Mean ± standard deviation	P value
Gender: Male Female)	203/291	3225/5449	0.08
age)	43.9±11.30	44.9±11.05	0.22
Height (cm)	169.7±6.51	169.2±8.15	0.382
Weight (kg)	72.87±11.62	71.26±13.37	0.046
Body mass index (kg/m)	25.22±3.56	24.75±3.51	0.041
Systolic blood pressure (mmHg)	114.3±14.21	118.8±14.46	0.524
Diastolic blood pressure (mmHg)	72.6±8.76	77.2±9.49	0.000
Hypertension (Y/N)	59/435(11.9)	1245/7430[14.4)	0.145
Diabetes (Y/N)	30/464(6.1)	475/8200(5.5)	0.54

As shown in the comparison results of the two groups in Table 2, there were no statistically significant differences in gender, age, height, systolic blood pressure, hypertension, and diabetes between the two groups. The weight, body mass index, and diastolic blood pressure of the observation group were higher than those of the control group. The difference was statistically significant (P<0.05).

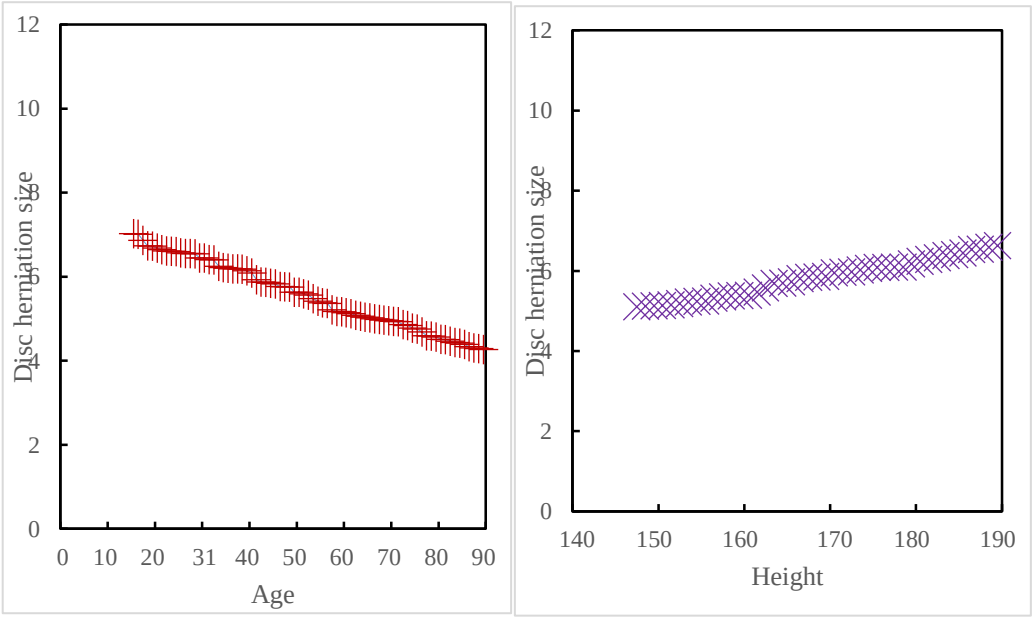

Figure 12. The correlation between the size of intervertebral disc herniation and age and height

As shown in Figure 12, disc herniation in patients with lumbar disc herniation decreases with age and may be associated with their physiological metamorphosis, where normal nucleus mededullary tissue dehydration and decreases with age. This may be due to increased disc pressure and shear

force as the height increases.

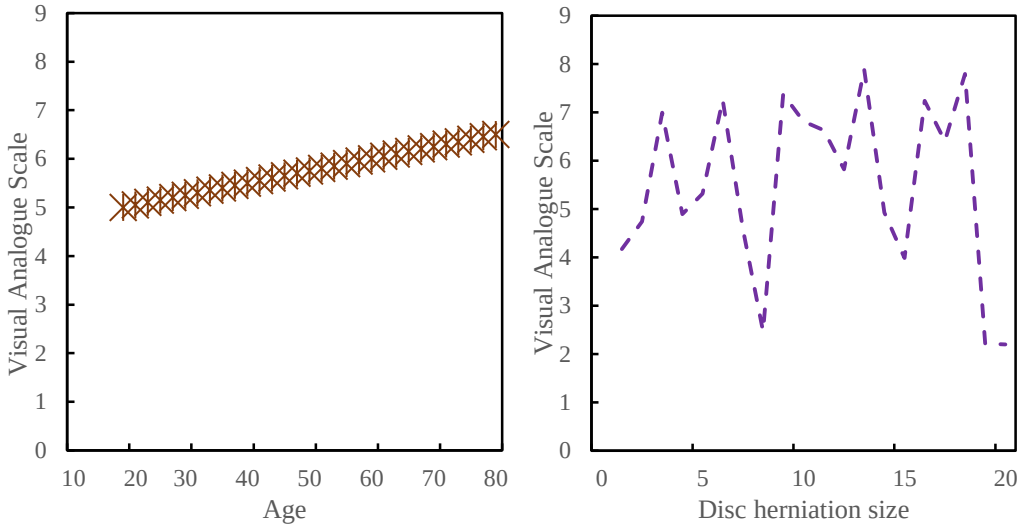

Figure 13. Correlation of VAC score with age and size of intervertebral disc herniation

As shown in Figure 13, patients with lumbar disc herniation decline older, but their clinical symptoms worsen. That is, the older the patient is, the prominence decreases, while the clinical symptoms are increasing.

5. Conclusion

With the development of society and the accelerating pace of people's lives, people's health and medical problems have attracted more and more attention. At present, various high-tech has been widely used in the medical field, and remarkable achievements have been made for all to see, making digital medical treatment possible. Diagnosis is the core content of medical problems. The accuracy and efficiency of diagnosis pay attention to people's lives and health. The digitalization of medical diagnosis is of great significance. From the perspective of the error of the model output, the improved neural network algorithm in this paper shows that the error of the BP neural network is the largest and unstable. The performance of the platform can be improved. There are still some shortcomings in the research of this paper. Artificial neural network itself has a wide range of applications in medical diagnosis. However, when the amount of information is large, the running time of the system increases exponentially with the increase of the amount of information, resulting in insufficient network structure. It is stable, and I hope to make a breakthrough in this area in the follow-up research.

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Data Availability

Data sharing is not applicable to this article as no new data were created or analysed in this study.

Conflict of Interest

The author states that this article has no conflict of interest.

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