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Application Analysis of Neural Network in Computer Network Security Evaluation

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Abstract: *As science and technology advance quickly, more and more people utilise the internet to interact with one another, yet the ensuing network security issue has garnered significant media attention. The elements that influence computer network security include things like as computer viruses, Trojan horses, and security flaws can lower the computer network's safety level. Building the evaluation criteria and procedures for the computer network security evaluation model is therefore essential. Directly impacted will be the security of the computer network. The current computer network security evaluation models' utilisation of all evaluation techniques may produce larger errors. However, this study integrates neural network technology into the computer network security evaluation system and combines the BP neural network technology optimised by the PSO algorithm and computer network security evaluation system to create an optimization-based neural network computer security evaluation system in accordance with the characteristics of existing computer network security evaluation models. According to the simulation results, the computer network security evaluation model of BP neural network technology based on PSO algorithm both increases the evaluation efficiency of network security and improves the evaluation accuracy of network security when compared to the existing computer network security evaluation models.*

Keywords: Neural network; Network security; Evaluation techniques; Particle Swarm Optimization(PSO) algorithm

I. INTRODUCTION

Due to the widespread use of computers and the growth of the Internet, network security issues are getting more and more significant as well as more regular and serious network communication. Computer viruses, Trojan horses, security flaws, and other elements, in particular, are the primary causes of computer network security issues[1]. Additionally, there are more intricate nonlinear relationships between the various components. Original computer network security assessment systems, such as the fault tree analysis approach, the analytic hierarchy process, the grey model, and others, have relatively low evaluation accuracy. Another alternative evaluation method is the so-called expert network security evaluation system, which necessitates the use of specialists with extensive evaluation background. Additionally, the results of the evaluation are not objective, and the safety evaluation lacks scientific rigour, which is inappropriate for the system in which the relationships between the evaluation components are intricate and varied. For many years, the neural network technology has been a popular research topic. The technology is capable of great self-improvement and adaptation, has an easy-to-use algorithm, and is effective against jamming. The evaluation of computer network security can be done scientifically and rigorously by combining the artificial intelligence model based on neural network technology with the evaluation model. Therefore, the model is appropriate for this stage of the evaluation of computer network security. In order to properly guard against the risk and lessen the loss brought on by computer network security issues, it is necessary to accurately and scientifically estimate the risk presented by the network [2].Computer network security was impacted by a number of variables, including intrusions, weaknesses, viruses, relationships between variables, and other variables. Between the complex nonlinear and the evaluation outcomes, there were factors. The operation of traditional evaluation methods for computer network security, such as analytical hierarchy process, fault tree analysis, and grey model, is complicated and difficult to precisely explain the nonlinear relationship, and evaluation accuracy is rather low [3].Since the idea of evaluating the security of a computer network was put forth, researchers have looked into and researched it from various angles. The ANNs (Artificial Neural Networks) is a mathematical algorithm model that simulates animal neutral network behaviour aspects and performs

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distributed parallel information processing [4, 5].It is ideally suited for evaluating computer network security because it can accurately capture the non-linear relationship between computer network security and attributes [6].

II. A COMPUTER NETWORK SECURITY INDICATOR AND PRINCIPLE EVALUATION

2.1 The Basics of Computer Network Security Assessment

The evaluation criteria serve as a reference for the evaluation of computer network security. The trusted computer criterion and evaluation rule established by the US Department of Defense in 1985 is the widely used network security evaluation criterion. Different countries construct similar evaluation criteria based on their actual conditions due to disparities in development advancement and degree.

2.2 Computer Network Security Evaluation Indicators

Due to the fact that a number of elements affect the network security, computer networks are extremely complex systems an alteration of the transmitted data that is security-related. Examples include the insertion of a code depending on the contents of the message, which can be used to validate the identity of the sender, and the encryption of the message, which scrambles it so that it is unreadable by the adversary. Some top-secret knowledge that the two leaders shared that, it is hoped, the rival was unaware of. An illustration would be the employment of an encryption key along with a transformation to scramble a message before transmission and unscramble it after receipt. A trusted third party may be needed to achieve secure transmission. For example, a third party may be responsible for distributing the secret information to the two principals while keeping it from any opponent. Or a third party may be needed to arbitrate disputes between the two principals concerning the authenticity of a message transmission. The assessment indicators for data security of the computer network system, computer network security in management security, and computer network security evaluation environment security are chosen in this study. The expert system is used to evaluate these indicators and determine their weight. The selected evaluation indicators are shown as the Fig. (1).

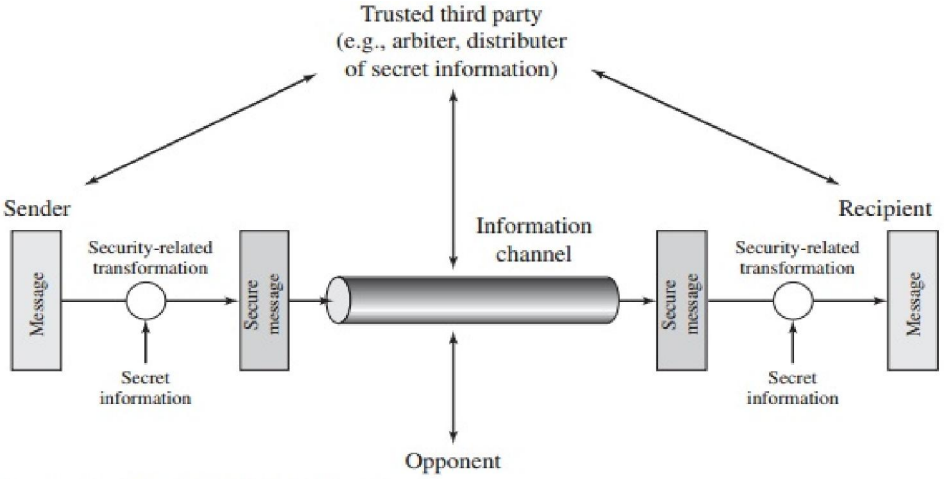

Fig. (1). Model For Of Network Security.

III. PSO-BPNN MODEL

3.1 Selection of the Computer Network Security Evaluation Index

Since computer networks are complex systems, many different factors can affect their security. It must first create a precise and scientific computer network security evaluation index system in order to properly assess their level of security. This page provides examples of how to handle the logical security, physical security, and computer network system security. The expert system might take into account the results of the computer network security evaluation index and decide the weight based on the chosen basis by experts, as illustrated in fig 2.

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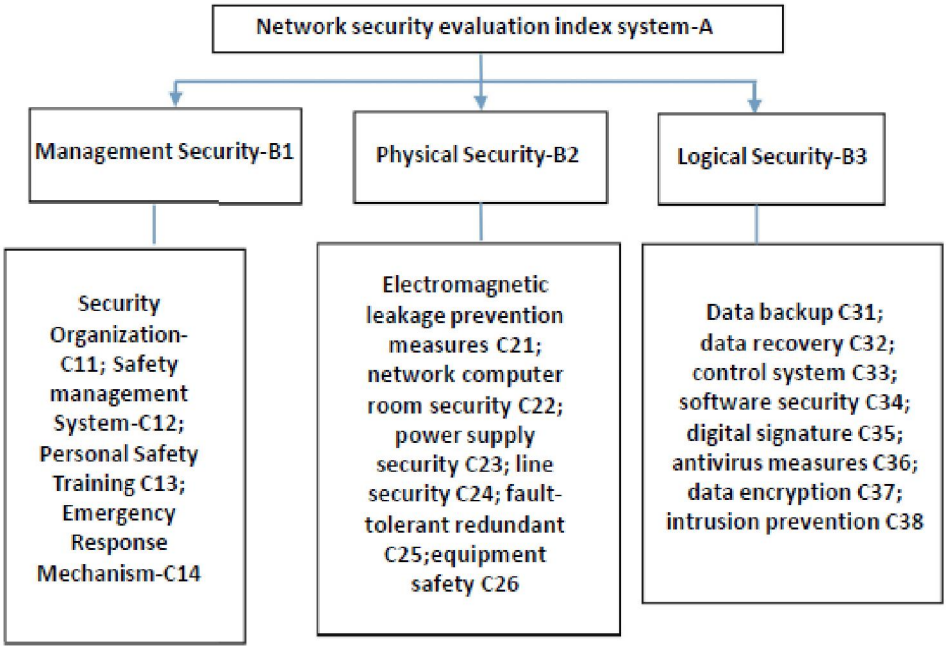

Fig 2. Computer Network Security Evaluation Index System

3.2 Computer Network Security Level Setting

In comparison to related study, it may be preferable to conduct a safety evaluation of the computer network, according to the comprehensive weight index**.** The computer network security level is broken down into four categories: absolutely secure (A), fundamentally unsafe (B), not safe (C), and extremely challenged (D) safe. The level of security is always set up for 1 point, and the exact equivalent points are displayed in table 1.

Classification	A	B	C	D
Score	1～0.85	0.85～0.7	0.7～0.6	0.6～0

Table 1. Computer network security level

3.3 The BP Neural Network Algorithm

The BP Neural Network Algorithm, Version 3.4One of the most often used neural network models is the BP neural network, which is a multilayer feed forward network based on error backward propagation[7].It employs the gradient descent technique, error back propagation network weights, and a constant adjustment threshold that is set between the expected neural network output and the output's actual sum of squared errors, which is the fewest. The BP neural network has good nonlinear approximation capabilities, is straightforward to design, and is prone to local minima. However, it is challenging to ensure convergence to the global minimum point and has weak global search capabilities. Additionally, because the back propagation gradient descent technique underlies the BP neural network, its poor convergence rate and unsatisfactory learning impact. In order to get beyond the BP neural network's intrinsic constraints, this paper uses the PSO algorithm.

1. The initialization of the BP neural network's topology, transfer function, and target vector.
2. Set the initial position and velocity of the particles, the momentum coefficient, the size and characteristics of the particle swarm, and the number of repetitions.
3. Utilizing the acutely trained BP neural network training set, the fitness value of each particle is assessed in accordance with type (5).
4. Compare each particle's current value to its best historical comparison, but only if the current value is superior to the best historicalfor the history of the individual best value, then save the current value of the particles;

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Compare the current value of theThe greatest way to preserve the current value of the history of the world's best particle swarm is to maximise its historical worth.value.

5. Inertia weight calculation.
6. Each particle's position and speed are updated, and each particle's fitness value error in the system is recorded.

3.4 Model for Evaluating Computer Network Security

In this paper, the PSO-BPNNPSO-BPNN model for computer network security evaluation is applied. First, the evaluation index system for computer network security is constructed. Next, the BP neural network is optimised using the particle swarm algorithm to achieve the best weights and optimal threshold. Finally, the optimised BP neural network model is used for computer network security evaluation.

IV. THE SIMULATION STUDIES

4.1 Training with the BP Neural Network

Due to space constraints, this paper does not include the train diagram since this study used the computer network security evaluation data set of 45 groups before the data of the BP neural network and PSO - BPNNPSO - the training BPNN model. The high precision error model for the traditional BP neural network shows in fig 3. the delayed convergence pace of the traditional BP neural network. The overall optimization capability is weak, which has a significant impact on the model's evaluation accuracy, leading to the local minimum value. Additionally, the PSO - BPNNPSO - BPNN model uses the PSO algorithm to successfully optimise BP Ly through the network increases network training speed, effectively increases training error precision, and significantly improves the entire optimization capability.

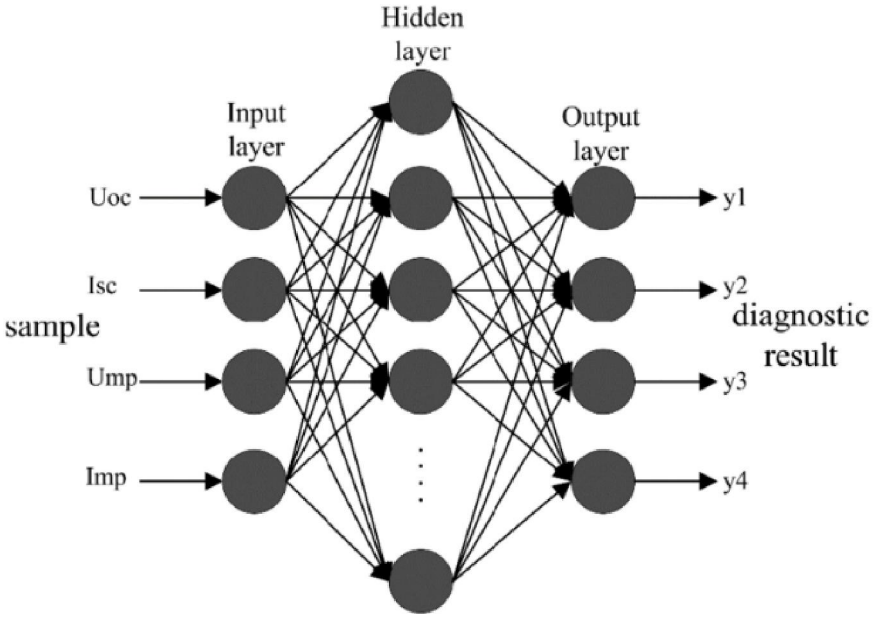

Fig 3. BP neural network

V. RESULTS AND EVALUATION

When a neural network has learned with the anticipated accuracy, save the web before testing it with the test set. The findings demonstrate that the typical BP neural network to 47 evaluation results of the computer network security data is incorrect; while the security level of the sample data is class C, which is hazardous, its evaluation results are also unsafe. By using PSO to optimise the BP neural network, evaluation accuracy was increased to 100%; in contrast, the traditional neural network's root mean square error was much higher than that of the BPNN model's PS0-based root mean square error, which was only 0. 023; this shows that the PS0 algorithm for BP neural network optimization was successful.

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VI. CONCLUSION

In this study, the PSO algorithm and the BP neural network were successfully used. The PSO algorithm was used to optimise the BP neural network. Utilize the BP neural network's strong nonlinear function to the fullest extent possible by employing it almost to capacity to assess the security of computer networks while taking into account that it has weak global search capabilities and a slow convergence rate into the bureau minute. The effective optimization threshold has been carried out using the PSO algorithm of the BP neural network, resulting in the weights of the network being the best and most threshold. As a result, the optimization of the parameters of the network has become fundamental, significantly enhancing the accuracy of the computer network evaluation. The PSO algorithm's findings from simulations demonstrate this. The usage of the PSO method is demonstrated by the necessity to optimise the BP neural network model for global search capability, evaluation precision, and convergence rate much greater than the typical BP neural network. The BP neural network has been successfully optimised for use in new network evaluation experiments.

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