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Exploration on Financial Risk Supervision System Based on Internet of Things and Improved Ant Colony Optimization Algorithms

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Abstract With the development of financial markets and the acceleration of globalization, financial risks have become more complex and diverse, and the traditional risk management methods are inefficient and inaccurate. In order to ensure the stable operation of financial institutions and protect the interests of investors, a financial risk supervision system based on the Internet of things and improved ant colony algorithm is designed to monitor the risk status of financial institutions in real time. The Internet of Things technology is used to collect and transmit financial regulatory data, and the collected data is used to assess and monitor the risks of financial markets and transactions, so as to provide decision support for regulators. The improved ant colony algorithm is used to optimize and improve the financial risk assessment model to improve the accuracy and efficiency of the assessment. The effectiveness and performance of the regulatory system in risk regulation are analyzed by testing and testing the system through experiments. In order to verify the effectiveness of the regulatory system, financial market and transaction data collected using iot technology are compared with traditional financial risk regulation methods. After a series of experiments, the average risk assessment accuracy of the system is 88.90%, the average financial risk supervision efficiency is 96.32%, and the average scalability score is 94.45. The system designed in this paper has good performance and can well meet the needs of financial risk supervision under the current complex economic situation.

Index Terms Financial Market, Financial Risk Supervision, Regulatory System, Internet of Things, Improved Ant Colony Algorithm

I. Introduction

Financial risk regulation is an important means to ensure the stability of financial markets and protect the interests of investors. With the continuous development of financial markets and the acceleration of globalization, financial risks show a trend of complexity and diversification, and traditional supervision methods can no longer meet the current needs. New technologies and means need to be introduced to improve regulatory efficiency and accuracy, reduce risk management costs and the probability of risk events. Ultimately, the system can effectively identify and manage risks, improve the efficiency and accuracy of regulatory authorities, and provide strong support for the stability and development of the financial industry.

IoT technology refers to connecting various items through the internet to achieve information transmission and interaction. Through the IoT technology, various data of financial institutions can be collected in real-time, thereby achieving comprehensive monitoring and management of the risk situation of financial institutions. Therefore, many people have conducted research on the application of IoT technology in the financial field. Nakashima Tokushi mentioned in his article that emerging technology keywords such as fintech and the IoT have received much attention in recent years. He explained that fintech, the IoT and other new technologies could be used to create truly accepted businesses, not only as a simple extension of existing business concepts, but also as a huge breakthrough [1]. Liu Lixin used multiple case researches to study how to jointly use the IoT and blockchain technology to mitigate financial risks in the supply chain. His research team conducted in-depth interviews to describe the business model and its novel ecosystem, to enhance the supply chain financial service capabilities of traditional banks [2]. Bhat Jagadeesha R mentioned in his research that in the current global trend, financial institutions were vigorously promoting smart finance to reap the dividends of digitalization. Technologies such as the IoT and blockchain simplified and enhanced several major financial services and processes, including loans, verification, fraud detection, quality maintenance and credit scoring [3]. Polymeni Sofia has proposed a new method for designing and evaluating IoT systems. Specifically, it identified principles that could be derived from the financial technology ecosystem and these principles should be considered when designing IoT systems to ensure their

technological reliability, cost-effectiveness and optimal market acceptance prospects [4]. The above researches are the application of IoT technology in the financial field by some researchers and have promoted the development of innovation in the financial field.

Ant colony optimization algorithms is an optimization algorithm designed to simulate the group behavior of ants searching for food. It can be used to solve many complex problems, including financial risk management. Therefore, many researchers have conducted corresponding research on ant colony optimization algorithms and its application in risk management. To improve the application ability of data mining in dealing with internet financial risk management, Feng Ran proposed a radial basis function (RBF) neural network algorithm based on ant colony optimization algorithm. His final research showed that the algorithm had a high accuracy rate in predicting internet financial market risk [5]. Ahmed Muhammed Kabir mentioned in his article that predicting capital market returns was crucial for financial markets. Due to the distribution of capital markets, he applied ant colony optimization algorithms suitable for solving distributed control problems. The final experimental results showed that the ant colony optimization algorithm had the highest accuracy, sensitivity and specificity in predicting the next day's closing stock price compared to the other three algorithms [6]. Jandaghi Gholamreza used data collected from 218 active companies on the Tehran Stock Exchange and over-the-counter trading between 1990 and 2016. In addition, he used ant colony optimization algorithms to determine the application risk of credit factors and utilized pattern recognition neural network technology to classify and evaluate the accuracy of bankruptcy prediction [7]. Based on bionic algorithm and deep learning, Wang Zeyu used ant colony optimization algorithms to design and optimize the back-propagation neural network model, aiming to optimize the time index of financial engineering and ameliorate the efficiency of financial decision-making. The final experimental results showed that the classification accuracy of the ant colony optimization algorithms model was 91.3% and the area under the subject's working characteristic curve was 0.867 [8]. The above contents are about some applications of ant colony optimization algorithms in financial risk management and control by various researchers. These studies show that ant colony optimization algorithms can effectively reduce risks in the financial field.

The financial risk supervision system based on the IoT and improved ant colony optimization algorithms is crucial to maintain the stability of the financial market and protect the interests of investors. It can not only identify potential risk points through data analysis and model prediction, but also flexibly adjust and optimize according to different risk situations and scenarios. In this paper, the IoT and the improved ant colony optimization algorithms are used to explore the financial risks existing in the regulatory financial market and the effectiveness of the financial risk regulatory system is verified through comparative experiments. The final results show that the financial risk supervision system based on the IoT and improved ant colony optimization algorithms can satisfy the demands of financial risk supervision in the current complex financial market environment.

II. Application of Internet of Things Technology in Financial Risk Supervision

Financial development is conducive to economic growth, but financial risks have a significant impact on both countries and individuals [9]. On the one hand, financial risks may lead to the collapse of the entire economic system, thereby having a serious impact on the development of the country and the lives of the people. On the other hand, financial risks may also pose a threat to personal property security [10]. Therefore, preventing financial risks is of great significance. In the financial field, the application of IoT technology has important implications. Firstly, it can achieve risk monitoring and management of financial institutions. Through the IoT technology, various data of financial institutions can be collected in real time, including balance sheets, cash flow statement, income statement and other aspects, thereby achieving comprehensive monitoring and management of the risk status of financial institutions. Secondly, IoT technology can increase the service level and efficiency of financial institutions. Through IoT technology, automated services and intelligent management can be achieved, thereby improving the service level and efficiency of financial institutions. Finally, IoT technology can promote financial innovation and development. Through IoT technology, innovation in financial products and upgrading of services can be achieved, thereby promoting the development and progress of the financial industry. The following Figure 1 is about the application of IoT technology in financial risk regulation.

Figure 2 shows the operational process of data collection and transmission. The IoT technology in financial risk regulation collects relevant data points through the deployment of IoT devices, which mainly include sensors, beacons, smart meters, surveillance cameras and other connecting devices. These IoT devices capture real-time information about various aspects of financial transactions, assets and operations, thereby achieving comprehensive monitoring and management of the risk situation of financial institutions. Then, IoT devices transmit the collected data to a central system or cloud platform for processing and analysis, usually through wireless protocols such as Wi-Fi (Wireless Fidelity), Bluetooth, cellular networks or specialized IoT communication standards such as MQTT (Message Queuing Telemetry Transport) and LoRaWAN (LoRa Wide Area Network). The final

transmitted data is stored on a cloud based platform or local server and advanced analysis technologies including machine learning and artificial intelligence are applied to process the collected data and extract valuable information from it.

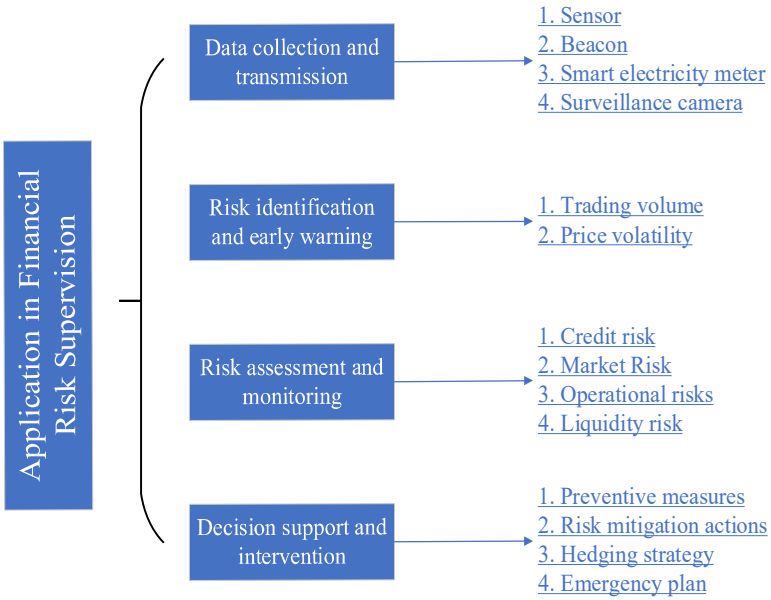

Figure 1: Application in financial risk supervision

Data collection and transmission

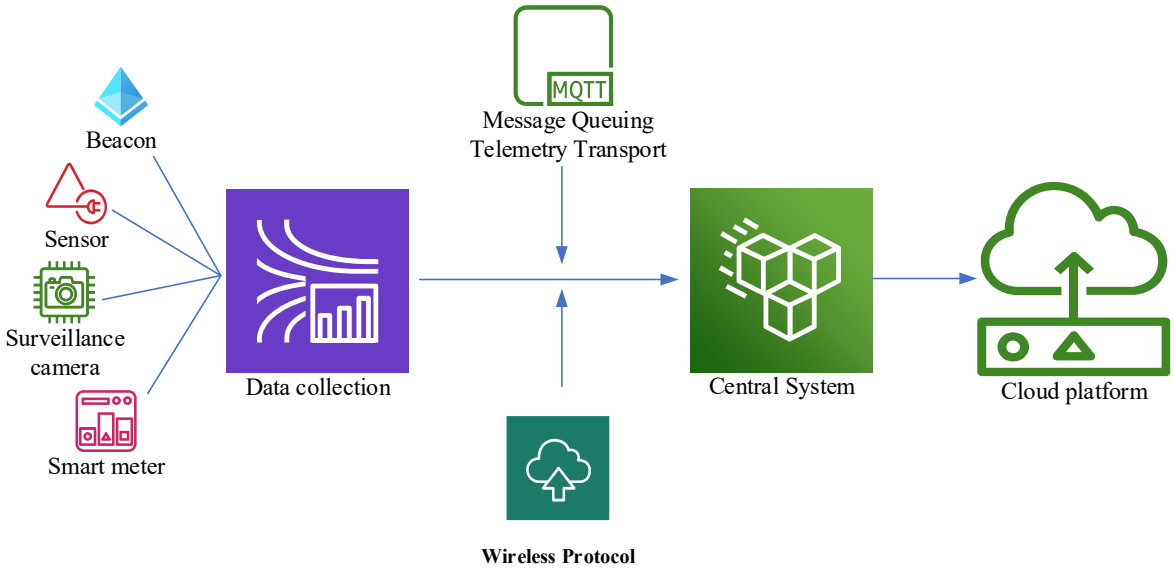

Figure 2: Financial regulatory data collection and transmission

Identification and early warning of risk events

After data collection and transmission is completed, the collected data needs to be preprocessed, including data cleaning, deduplication, filling missing values and other operations to improve the accuracy and reliability of the data. Useful feature information is extracted from the preprocessed data for subsequent risk event identification and early warning. The corresponding model is established by machine learning and other algorithms, and the extracted feature information is analyzed and predicted to identify potential risk events. Once potential risk events are found, iot technology is used to monitor and track the development of these events in real time, send out early warning

signals in time, and notify relevant agencies to take corresponding risk prevention and response measures. In financial risk supervision, Internet of things technology has the characteristics of efficiency, accuracy and real-time in identifying and warning risk events, helping financial institutions to find and respond to potential risk events in time, and ensuring the stability and development of financial markets.

Risk assessment and monitoring

Figure 3: Financial risk assessment system page

After the completion of data collection, transmission and identification and early warning of risk events, the corresponding risk model is developed by analyzing the data through data mining and machine learning techniques. These models are used to quantify and measure different types of financial risks and integrate relevant variables in iot data to improve the accuracy of the model. Then a user-friendly financial risk supervision system interface is created as shown in Figure 3, providing a visual representation of financial risk assessment and monitoring. The main interface mainly includes six sections: home page, data management, risk model management, real-time query, report management and system management. The main content of the home page section includes the following aspects: the information of the current operating account is displayed in the upper left corner of the interface; on the upper right is a real-time interface for 24-hour real-time financial market risk warning; the lower left corner displays real-time risk management actions, real-time anomaly warnings, and visualization of risk trends and patterns. This financial risk assessment system allows financial decision-makers to make effective decisions based on the current financial risk situation. Ultimately, based on feedback, data analysis and IoT technology, financial risk assessment and monitoring systems are regularly evaluated and improved. Ensuring that the system remains effective and adaptable to the changing risk situation by keeping pace with the latest developments in iot and related fields provides guidance for real-time monitoring of financial risk indicators using iot technologies.

Decision support and intervention

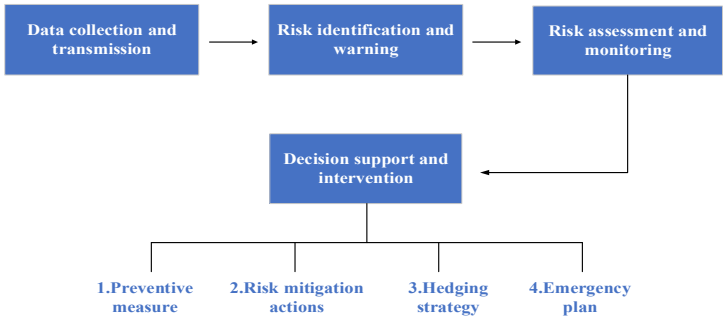

Figure 4: Flowchart of decision support and intervention

Figure 4 illustrates the process of support versus intervention in financial monitoring decisions. After completing a series of operations such as data collection and transmission, risk event identification and early warning, risk

assessment and monitoring, intervention strategies are developed based on the assessment results of risk assessment and iot data to deal with the identified risks. These strategies include preventive measures, risk mitigation actions, hedging strategies, and contingency plans. Reduce response times and minimize the potential impact of risks by automating risk mitigation measures. Periodically assess the performance of financial risk assessment systems, analyze the results of interventions, and refine models and strategies as needed. This iterative process ensures that the system maintains effective financial risk management in a dynamic environment.

III. Application of Improved Ant Colony Optimization Algorithms in Financial Risk Supervision

III. A. Principle of Improved Ant Colony Optimization Algorithms

Ant colony optimization algorithm is an optimization algorithm developed by simulating the behavior of ants searching for food [11], [12]. This algorithm is mainly used to solve the shortest path problem, and has been successfully applied to TSP [13]. By simulating the pheromone released by ants in the process of finding food and guiding other ants to find food along the shortest path, the optimization of solving the problem was realized [14], [15]. The core of ant colony optimization algorithm is pheromone model and heuristic rules. The closer the pheromone is, the greater the release amount of pheromone is. This ensures that each ant can approach the optimal solution as closely as possible. Heuristic rules refer to some rules introduced during the search process to avoid falling into local optima.

In the initial stage of the algorithm, the pheromone value is fixed, which makes the ants have some blindness in the exploration process. Therefore, despite calculation and optimization, the shortest path found by the algorithm may still increase. Here, this article refers to Wang Yang's article titled "A time-sensitive network scheduling algorithm based on improved ant colony optimization". The improved ant colony algorithm he used in his article could effectively schedule time triggered flows in time sensitive networks, and was superior to traditional ant colony algorithms in terms of convergence speed, optimization ability, and local optimal trap tendency [16]. To improve the convergence speed and optimization ability of traditional ant colony algorithm in financial risk assessment models, the pheromone calculation method is improved. The improved calculation method calculates the initial pheromone based on the relative distance between the current node, the next node and the starting point connection.

$$\tau_{ij} = \frac{L_T}{L_N + L_{ij} + L_D} * k \qquad j \in G \tag{1}$$

In the above Formula 1, L_T and L_N are the Euclidean distances from the start point to the end point and the current node, respectively; L_{ij} and L_D are the Euclidean distances from the next node to the current node and the end point, respectively; *G* is the set of the next node; *K* is a constant. Without considering the current node and the position of the next node, the selected path may not necessarily be the shortest path and to accelerate the convergence speed, the influence of heuristic information on path selection is weakened. So here, the heuristic information function is improved by introducing damping coefficient *n*.

$$\sigma_{ij} = \frac{1}{L_{ij} + L_{mn}} * \varphi \tag{2}$$

$$\varphi = \begin{cases} \frac{IT_{Max} - IT}{IT_{Max}}, & IT_{Max} \neq IT \\ \frac{1}{IT_{Max}}, & IT_{Max} = IT \end{cases} \tag{3}$$

In Formulas 2 and 3 above, L_{mn} is the Euclidean distance between node *m* and target node *n*; IT_{Max} and IT are the maximum and the current number of iterations, respectively. After all ants complete the iteration, the pheromone on the path is updated. At this point, any complete path is able to find the best and worst solutions.

$$\Delta\tau_{ij} = \begin{cases} \frac{1}{P_{best}}, & Path\ (i,j)\ is\ the\ optimal\ path \\ -\frac{1}{P_{worst}}, & Path\ (i,j)\ is\ the\ optimal\ path \\ 0, & Other \end{cases} \tag{4}$$

In Formula 4, P_{best} and P_{worst} are the lengths of the current best and worst path. To avoid algorithm stagnation, the range of pheromone is set to $[\tau_{min}, \tau_{max}]$.

$$\tau_{ij}(t) = \begin{cases} \tau_{max}, & \tau_{max}(t) \geq \tau_{ij}(t) > \tau_{ij}(t+1) \\ \tau_{ij}(t), & \tau_{max}(t) > \tau_{ij}(t) > \tau_{ij}(t+1) \\ \tau_{min}, & \tau_{min}(t) \geq \tau_{ij}(t) \end{cases} \tag{5}$$

Through the above improved ant colony optimization algorithms, it is possible to process large-scale data sets and find the optimal solution in a short time. In addition, by improving the calculation method of pheromone, the improved algorithm can adjust the release amount of pheromone, heuristic rules and other parameters to adapt to different problems and data sets. It has the global search ability and can find the global optimal solution in the search space, enhancing the robustness and accuracy of the algorithm.

III. B. Risk Assessment and Optimization

The financial system of a country is an important tool for its economic development, which helps to create wealth and link savings with investment [17], [18]. The financial market is a highly complex and dynamic system, which includes various financial institutions and products such as banks, securities, insurance, funds, etc. The risk sources of these institutions and products are very diverse. Financial risk assessment refers to the process of analyzing, identifying, measuring and controlling risks in the financial market. Financial risk assessment can not only help investors understand the risks faced by investment products, make more intelligent investment decisions and protect their own investment interests, but also find potential risks in the market and take timely measures to supervise and control, thus promoting the stability and development of the market. The following is the financial risk assessment model optimized by ameliorating the ant colony optimization algorithms. The specific calculation formula is as follows:

$$RIA = \tau_{ij}(t)x_{ij} - \Delta\tau_{ij}y_{ij} \tag{6}$$

In Formula 6, x_{ij} is a financial asset category item, including various liquidity asset elements; y_{ij} is a financial liability category item; τ_{ij} and $\Delta\tau_{ij}$ are the weights of financial asset project element indicators and financial liability project element indicators obtained by improving the ant colony optimization algorithms respectively. Then, by extracting the maximum characteristic function of the financial risk assessment values of listed banks, the specific calculation formula is as follows:

$$Max\ (FRC_{ij}) = \frac{\tau_{ij}(t)x_{ij}}{\Delta\tau_{ij}y_{ij}} \tag{7}$$

The calculation formula for the bottom line of financial risk in the financial market is:

$$FBR = \Delta\tau_{ij}y_{ij} - FRC_{ij} \tag{8}$$

By improving the ant colony optimization algorithms, the purpose of predicting financial risks and preventing financial risks is achieved. In view of the various financial risks that may occur under the current complex economic environment in the world, a more comprehensive assessment and prediction can be achieved and the financial risks in the financial market can be predicted comprehensively and stereoscopically. Additionally, the model makes the financial market risk response plan more feasible, scalable and flexible.

III. C. Decision Making and Optimization

By using the improved ant colony optimization algorithms, the decision-making process of the regulatory authority can be more scientific and reasonable and the quality and effect of decision-making can be improved. Specifically, the improved ant colony optimization algorithms can optimize the decision-making process of regulators through the following aspects:

Improving the search efficiency: the improved ant colony optimization algorithms can limit the number of steps moved in each iteration and the number of ants in each iteration and other ways, thereby discovering the optimal solution faster.

Avoiding falling into the local optima: the algorithm can design some heuristic rules according to the characteristics of the problem and the objective function to avoid falling into the local optimal solution, thereby finding the global optimal solution.

Enhancing the global search ability: the improved ant colony optimization algorithms can enhance the ability by increasing the weight of pheromone, randomness and other ways, so as to better find the potential optimal solution.

Supporting multi-objective optimization: improved ant colony optimization algorithms can support multi-objective optimization, that is, consider multiple objective functions simultaneously, thereby better satisfying the demands of regulators. For example, when considering risks and benefits, cost, time and other factors should be considered.

Overall, the use of improved ant colony optimization algorithms can make the decision-making process of the regulatory authority more scientific and reasonable and improve the quality and effect of decision-making. By simulating the behavior of ants, the improved ant colony optimization algorithms can automatically adjust the value and position of heromone in the search process to find the optimal solution. Meanwhile, the improved ant colony

optimization algorithms also has high adaptability and robustness and can be applied in different problem scenarios [19].

IV. Experiment and Result Dissection of Financial Risk Assessment

In economic activities, various uncertainties may lead to the risk of losses or the inability to realize expected benefits in investment or financing activities. Financial risk is a challenge that financial institutions must face, which directly affects the profitability and stability of financial institutions. The traditional way of financial risk supervision relies too much on the past experience and mode, lacks innovation and flexibility, has strong lag and inadaptability, and cannot deal with the emerging financial business and risk. The supervision system in this paper can realize the automatic collection, analysis and processing of data, reduce the degree of manual intervention, and improve the efficiency and accuracy of supervision. In order to verify the effectiveness of this system, the accuracy, efficiency and scalability of financial risk assessment are studied by collecting financial market and transaction data, including historical data and real-time data. The detailed experimental results are as follows.

(1) Accuracy of assessment

Accuracy of assessment is an important indicator for evaluating the effectiveness of financial risk supervision systems based on IoT technology and improved ant colony algorithm. If the financial risk supervision system based on IoT technology and improved ant colony algorithm cannot accurately identify and predict risks, its effectiveness may be questioned. The indicator accuracy of the assessment can help determine whether the performance of the financial risk supervision system meets expectations and provide guidance for further optimization and improvement. To verify the advantages and disadvantages of the system proposed in this article in terms of assessment accuracy and traditional financial risk supervision methods, the traditional financial risk supervision methods are set as a control group, mainly examining the accuracy of market risk, credit risk, liquidity risk, and operational risk assessment. The experimental results of the specific accuracy of risk assessment are shown in Figure 5.

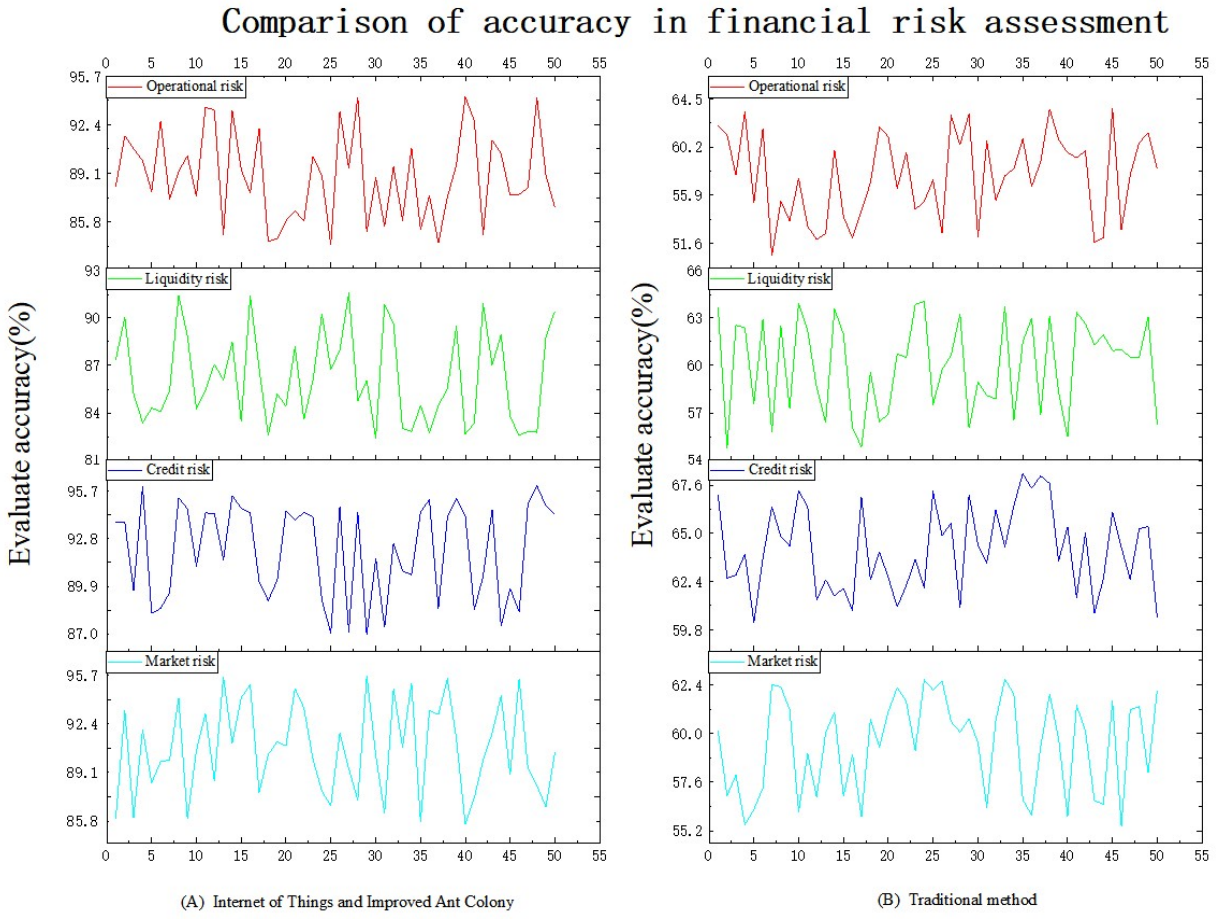

Figure 5: Accuracy of financial risk assessment

Figure 5A: Accuracy of financial risk assessment of IoT technology and improved ant colony optimization algorithms

Figure 5B: Accuracy of financial risk assessment of traditional methods

Table 1: Analysis of data accuracy

Risk type	Sample size	IoT and Improved ant colony optimization algorithms			Traditional methods		
		Over 90%	Below 90%	Proportion (over 90%)	Over 60%	Below 60%	Proportion (over 60%)
Market risk	50	19	31	38%	26	24	52%
Credit risk	50	29	21	58%	50	0	100%
Liquidity risk	50	8	42	16%	28	22	56%
Operational risk	50	17	33	34%	16	34	32%
Total	200	73	127	36.5%	120	80	60%

The results of the comparative experiment on the accuracy of financial risk assessment are shown in Figure 5A and Figure 5B. The comparative experiment examined the accuracy of the assessment of market risk, credit risk, liquidity risk and operational risk and 50 groups of experiments were set for each risk. From Figure 5, it can be seen that the financial risk supervision system based on IoT technology and improved ant colony algorithm overall exceeded 80% in terms of risk assessment accuracy, while the accuracy of traditional financial risk assessment methods was generally lower than 70%. Among them, the financial risk supervision system based on IoT technology and improved ant colony optimization algorithms had the highest accuracy in risk assessment, which reached 94.01% for market risk assessment and the average accuracy of risk assessment of all 50 groups of experimental data was 89.06%. The highest accuracy of credit risk assessment was 94.58% and the average accuracy of risk assessment for all 50 experimental data groups was 90.65%. The highest accuracy of liquidity risk assessment reached 91.57% and the average accuracy of risk assessment of all 50 groups of experimental data was 86.20%. The highest accuracy of operational risk assessment was 94.29% and the average accuracy of risk assessment for all 50 experimental data groups was 88.90%. In conclusion, the average risk assessment accuracy of the financial risk supervision system based on IoT technology and improved ant colony optimization algorithms was 88.7%. For traditional financial risk assessment methods, the highest accuracy of market risk assessment was 62.67% and the average accuracy of risk assessment for all 50 sets of experimental data was 59.45%. The highest accuracy of credit risk assessment was 68.23% and the average accuracy of risk assessment for all 50 experimental data groups was 64.15%. The highest accuracy of liquidity risk assessment reached 64.06% and the average accuracy of risk assessment of all 50 groups of experimental data was 60.02%. The highest accuracy of operational risk assessment was 63.66% and the average accuracy of risk assessment for all 50 experimental data groups was 57.62%. Concluded from the experimental data, the average risk assessment accuracy of traditional financial risk assessment methods was 60.31%. Additionally, as can be seen from Table 1, the financial risk supervision system based on the IoT technology and improved ant colony optimization algorithms accounted for 36.5% of those whose risk assessment accuracy exceeded 90%. The accuracy of traditional financial risk assessment methods exceeded 60%, accounting for 60%.

(2) Regulatory efficiency

It is self-evident that the regulatory efficiency index is important to evaluate the effectiveness of the financial risk regulatory system of this paper. Only when the regulatory efficiency is effectively improved can the stable operation of the financial market be better guaranteed and the interests of investors be protected. To verify the performance of the financial risk supervision system based on IoT technology and improved ant colony optimization algorithms in terms of supervision efficiency and traditional financial risk supervision methods, this paper conducted a comparative test on the two methods. To accurately evaluate the supervision efficiency of the two methods, professional financial market regulators were invited to evaluate the supervision efficiency of the two methods. The final specific experimental results of evaluating the efficiency of financial risk regulation are depicted in Figure 6.

The results of the efficiency evaluation of financial risk regulation for the two methods are shown in Figure 6. It can be seen that the financial risk supervision system based on IoT technology and improved ant colony algorithm had significantly higher efficiency compared with traditional methods for financial risk supervision. From Figure 6, it can also be seen that the financial risk supervision efficiency of the financial risk supervision system based on IoT technology and improved ant colony algorithm was relatively stable. Additionally, according to Table 2, the supervision efficiency of this paper's the financial risk supervision system was generally higher than 90% and the proportion of financial risk supervision efficiency evaluated as excellent reached 100%. On the contrary, the efficiency evaluation of traditional financial risk supervision methods was generally average, while the proportion of

those with poor efficiency evaluation reached 20%. According to the analysis of experimental data, the financial risk supervision system based on IoT technology and improved ant colony optimization algorithms had the highest supervision efficiency as the eighth group and its financial risk supervision efficiency has reached 97.84%. The first group had the lowest supervision efficiency and its financial risk supervision efficiency was 92.62%. By calculating all 10 groups of experimental data, its average financial risk supervision efficiency was 96.32%. Looking at the risk supervision efficiency of traditional financial risk supervision methods, the third group had the highest supervision efficiency, with a financial risk supervision efficiency of 72.73%. The fifth group had the lowest supervision efficiency, with a financial risk supervision efficiency of 59.17%. By calculating all 10 sets of experimental data, the average financial risk supervision efficiency was 65.39%.

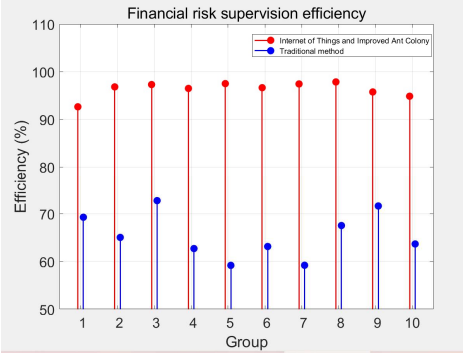

Figure 6: Efficiency of financial risk supervision

Table 2: Evaluation criteria and level evaluation of processing speed

Efficiency(%)	0-59.99	60-89.99	90-100
Rank	Bad	Normal	Good
IoT and Improved ant colony	0	0	10
Traditional methods	2	8	0

(3) Scalability

Scalability index is one of the important indexes to evaluate the effectiveness of a system. Without scalability, the regulatory system cannot cope with changes in different types of financial products and markets, and cannot meet the increasing volume of data and complex risk management needs. When evaluating the effectiveness of the financial risk supervision system based on iot technology and improved ant colony optimization algorithm, its scalability should also be considered. To test the performance of the system in handling different types of financial products and market situations, as well as its adaptability to increasing data volumes and changing risk management requirements. To verify the scalability of this paper's the financial risk supervision system, the traditional financial risk supervision methods were set as the control group, scoring and evaluating the scalability of the financial risk supervision system. The final experimental results are depicted in Figure 7.

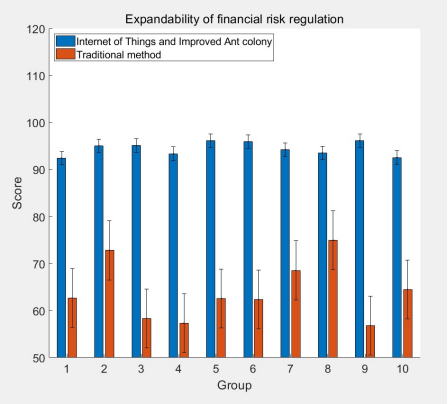

Figure 7: Scalability of financial risk regulation

Table 3: Financial risk regulation scalability rating standards and rating status

Score	0-59.99	60-89.99	90-100
Rank	Bad	Normal	Good
IoT and Improved ant colony	0	0	10
Traditional methods	3	7	0

The results of the scalability assessment of financial risk regulation for the two methods are shown in Figure 7. It can be seen that the standard deviation of the scalability of financial risk supervision systems based on IoT technology and improved ant colony algorithm was smaller. In Figure 7, all 10 sets of experimental data on the scalability of financial risk regulation had relatively small fluctuations, while the standard deviation of the traditional methods compared to them was significantly larger. From Figure 7, it can also be observed that the oscillation amplitude of the 10 experimental data sets was even greater. In addition, it can be seen from Table 3 that the scalability evaluation level of the financial risk supervision system based on IoT technology and improved ant colony algorithm was excellent, accounting for 100%, while the accuracy evaluation level of traditional methods was average, accounting for 70%. Next, experimental data on the scalability of financial risk regulation using two methods was studied. The ninth group had the highest scalability score for the financial risk supervision system based on IoT technology and improved ant colony algorithm, with a scalability score of 96.14 points, and the first group had the lowest scalability score, with a scalability score of 92.42 points. The average scalability score of all 10 experimental data groups was 94.45 points. As for the experimental results of traditional methods, the eighth group had the highest scalability score with a scalability score of 74.96; the ninth group had the lowest scalability score, with a scalability score of 56.81. The average scalability score for all 10 experimental data groups was 64.09.

V. Conclusions

According to the above experimental analysis, in the process of research on financial risk supervision, the financial risk supervision system based on IoT technology and improved ant colony optimization algorithms can improve the accuracy of financial risk supervision compared with traditional financial risk supervision methods. The improved ant colony optimization algorithms can design corresponding heuristic rules according to the characteristics of the problem and the objective function and enhance the global search ability by increasing the weight of pheromone, randomness and other ways, thereby making the decision-making process of financial regulators more scientific and reasonable and improving the quality and effect of decision-making. Finally, with the assistance of IoT technology and improved ant colony optimization algorithms, it provides a good solution to the problems existing in the traditional financial risk supervision methods and also has a high accuracy of risk assessment and supervision efficiency. To verify the effectiveness of the financial risk supervision system based on the IoT technology and improved ant colony optimization algorithms, this paper conducted a comparative experiment with the traditional financial supervision methods. This comparative experiment examined the three evaluation indicators of evaluation accuracy, supervision efficiency and scalability. The final experimental results showed that the financial risk supervision system based on IoT technology and improved ant colony optimization algorithms not only had high accuracy and supervision efficiency in financial risk assessment, but also had high scalability.

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