Application of SOM-GAN based deep learning technology in the security protection of rural bank depositors' funds information

Wenjia Wu [1, *], Minglei Han [2], Yandong Hu[3], Jiaqi Ma [4], Xiaolei Zhang [5]

[1]School of Finance, Harbin University of Commerce, Harbin, China

[2]Harbin University of Commerce Talent School, Harbin, China

[3]School of Computer and Information Engineering, Harbin University of Commerce, Harbin, China

[4]School of Finance and Public Relations Management, Harbin University of Commerce, Harbin, China

[5]School of Economics and Management, Shandong Jiaotong University, Jinan, China

*Corresponding author: m18964799825_1@163.com

Abstract. Since the reform and opening up, the status of China's banking industry has been significantly improved, and the traditional banking industry has gradually cross-integrated with Internet technology [1], which has become an important support for national economic development and a core component of the financial system. For example, in the original physical bank and online bank, new Internet financial models have been expanded, such as online financial management, bank electronic accounts, mobile banking, P2P models, third-party payment platforms, crowdfunding, etc. [2]. However, in the period of rapid development of the transformation and upgrading of traditional banks facilitated by information technology, many problems have emerged, such as the relaxation of supervision, the lag of policies and regulations, and the difficulty of reasonable protection of private data, etc. These problems may affect the interests of depositors and even the state. For example, in 2022, China's Henan rural bank 40 billion event, this event involved about 400,000 depositors, and platforms such as Du Xiaoman and Xiaomi Finance have related cooperation with these rural banks. Therefore, reasonable security protection of depositors' fund information and information processing and encryption under certain deep learning technology have long become the focus of experts' research in information technology. For example, Tian Gengwen has conducted an in-depth discussion on customer information security in the digital transformation of banks [3]. For example, Yang Wanrong conducted an in-depth study on the path and measures of data security governance of small and medium-sized banks [4]. For example, Zhang Wenli, Peng Xiaolei et al have made an in-depth elaboration on the bank data security solution [5]. Following hot issues closely, this paper provides a method of deep learning technology based on SOM-GAN in the security protection of rural bank depositors' funds information, aiming to combine the advantages of self-organizing mapping neural network and generative adantagonistic network unsupervised learning. At the same time, it can complement the competition mode of self-organized neural network, generate the discriminant characteristics of adversarial network and generate real data to process and review the relevant data of the fund information security of rural bank depositors, ensure the fund management security of rural bank depositors, and realize the monitoring and analysis of their funds and the surrounding environment when depositors are storing funds. Thus, the security, confidentiality, authenticity and integrity of depositors' funds information are guaranteed, and hidden dangers such as theft of depositors' funds, loss of depositors' personal information and threats to depositors' personal information security brought about by the 40bn deposit red code incident of Henan Bank in 2022 are eliminated.

Keywords: The Financial System, Customer Information Security, Financial information security.

1. Existing background technology

1.1. Transaction Monitoring

Transaction monitoring is one of the most beneficial applications of machine learning in banking. Transaction monitoring refers to real-time, comprehensive monitoring and analysis of trading activities in financial markets to detect abnormal trading behavior, potential risks and irregularities. Here are some common contents and purposes of trade monitoring:

a) Monitoring trading activity: A transaction monitoring system can monitor trading activity in financial markets in real time, including the trading of various assets such as stocks, bonds, futures, etc. It can record and analyze the transaction price, quantity, time and other information.

b) Discover abnormal trading behavior: The transaction monitoring system can detect abnormal trading behavior by setting early warning rules and models, such as abnormal price fluctuations, abnormal trading volume, abnormal trading time, etc. Once an anomaly is found, the system will send an early warning signal in time, so that the regulatory department or the exchange can take corresponding measures.

c) Risk prevention: Transaction monitoring can help financial institutions and regulators discover potential risks in a timely manner. By monitoring trading activities, it can identify possible market manipulation, insider trading, money laundering and other risky behaviors, so that appropriate preventive measures can be taken to protect the fairness and stability of the market.

d) Guarantee market fairness: Transaction monitoring helps to maintain market fairness and transparency. By monitoring trading activities, it is possible to detect and prevent market manipulation, fraudulent trading and other misconduct, and ensure that all trading participants trade in a fair market environment.

e) Assist investigation and law enforcement: The trading data and analysis results provided by the transaction monitoring system can be used as evidence for investigation and law enforcement. Regulators and law enforcement agencies can make use of the data analysis function of the transaction monitoring system to strengthen the review and fight against violations.

In general, transaction monitoring is one of the important means of financial market regulation. Through real-time monitoring and analysis of trading activities, abnormal trading behaviors can be detected, risks can be prevented, market fairness can be maintained, and investigation and law enforcement can be assisted. However, the existing transaction monitoring technology can not solve the problems of privacy and data protection, nor can it cope with and deal with complex and diversified transaction patterns. Moreover, the construction and maintenance of an effective transaction monitoring system requires a large amount of cost and resource investment, so the transaction monitoring system can not completely solve the problems faced by the security protection of depositors' information.

2. Overview of key technologies

2.1. SOM Overview

SOM is an unsupervised learning algorithm for mapping high-dimensional data into low-dimensional Spaces. It was proposed by Finnish scientist Teuvo Kohonen in 1982 and has been widely used in the field of machine learning. The basic principle of SOM is to use neural networks to simulate the self-organization and clustering behavior of the cerebral cortex. It uses competition and cooperation mechanisms in the learning process to form a topologically ordered mapping, that is, mapping input data samples into a two-dimensional or higher-dimensional grid structure. In this way, similar data samples will be assigned to adjacent areas in the mapping space, forming a clustering effect. SOM can play the following roles in the protection of depositors' information security in rural banks:

a) Anomaly detection: SOM can map the depositor's fund transaction data into a topologically ordered mapping space. By observing and analyzing the distribution of the depositor's fund transaction data in the mapped space, abnormal transactions that are not consistent with normal transaction patterns can be identified. This helps detect and prevent depositors' funds from being exposed to risks such as fraud and money laundering in a timely manner.

b) Anti-fraud measures: The SOM can do this by mapping the depositor's money transaction behavior to the SOM and forming a topological representation of normal behavior. When new transaction data diverges significantly from known normal behavior, it can be treated as potential fraud. This helps banks implement anti-fraud measures to stop fraud in a timely manner and keep depositors' funds safe.

c) Personalized services: SOM can map data such as depositors' spending habits and financial status to the SOM and group depositors based on similarity. By analyzing the characteristics and needs of different groups of depositors, the bank can provide personalized financial services and product recommendations for each depositor. This helps boost customer satisfaction and loyalty.

d) Data analytics and decision support: SOM can help banks visualize and explore depositor data. By mapping depositor's fund transaction data to the SOM, correlations between depositors and the characteristics of different depositor groups can be observed and analyzed. This helps the bank to conduct data analysis and decision support, optimize product design, marketing and other strategies.

2.2. Overview of Gans

Deep learning models can be roughly divided into discriminative modules and generative modules. At present, the achievements of deep learning mainly focus on discriminative modules, while generative modules are an extremely challenging machine learning problem. First, modeling the real world requires a large amount of prior knowledge, and the quality of modeling directly affects the performance of generative modules; Secondly, the data in the real world is often very complex, and the amount of computation required to fit the model is often very large, or even unbearable. In 2014, Goodfellow proposed a new generative module, generative Adversarial network (GAN), which uses adversarial training mechanism to train two neural networks.

GAN is a kind of deep learning model, which is composed of generator and discriminator, and learns the distribution characteristics of data by fighting with each other. The generator tries to generate samples that are similar to the real data, while the discriminator tries to distinguish between the real data and the data generated by the generator. Through continuous iterative training, the generator and discriminator can improve each other and eventually reach the goal of generating realistic samples. GAN can play the following roles in the security protection of depositors' funds information in rural banks:

a) Data synthesis and privacy protection: Rural banks usually have a large amount of depositors' funds information data, including transaction records, account balances, etc. However, using these real data directly for research or sharing may involve privacy issues. By using Gans, synthetic data similar to real data can be generated for data analysis, model training and other purposes, while protecting depositors' private information.

b) Anomaly detection and risk assessment: Gans can generate synthetic data similar to the depositor's fund trading behavior. By comparing the synthetic data with real data, abnormal transactions and potential risks can be identified. This helps banks detect and respond to threats such as fraud and money laundering in a timely manner, and protects depositors' funds.

c) Data enhancement and model training: Synthetic data generated by Gans can be used for data enhancement and model training. By generating more synthetic data, the diversity and number of data samples can be increased, and the generalization ability and robustness of the model can be improved. This will help to improve the performance and effect of the model on the security of depositors' funds information.

3. Shortcomings of traditional deep learning techniques

3.1. Data requirements and privacy issues

Traditional deep learning models usually require a large amount of labeled data for training, but it may be difficult to obtain enough labeled data in the security protection of depositors' funds information. In addition, the personal privacy of depositors also needs to be fully protected, and the traditional deep learning model may lead to the risk of privacy disclosure when dealing with sensitive data. The SOM-GAN proposed in this paper, however, can be trained through unsupervised learning and does not require large amounts of labeled data. It is able to learn from unlabeled data and find potential patterns and structures in the data, thus reducing the dependence on labeled data. In this way, SOM-GAN can reduce the work of data collection and labeling in the security protection of depositors' funds information. In addition, SOM-GAns can apply differential privacy technology to protect the personal privacy of depositors by adding noise or disturbance. By introducing differential privacy mechanisms into the generation model, SOM-Gans can protect sensitive data and reduce the risk of privacy disclosure.

3.2. Interpretability of the model

Model interpretability: The complexity of deep learning models results in their poor interpretability. In the security protection of rural bank depositors' funds information, the decision-making process of the model needs to be explained and reviewed to meet the regulatory and compliance requirements. However, the black-box nature of traditional deep learning models makes it difficult to explain model decisions. Compared with the black-box property of traditional deep learning models, the SOM-GAN model proposed in this paper has some explanatory properties. The self-organizing mapping layer in SOM-GAN can map high-dimensional data to two-dimensional or three-dimensional space to form visual results. In this way, it is easier to understand the process of data processing and generation by the model, and improve the interpretability and interpretability of the model.

4. SOM-GAN systems and devices

4.1. Model framework of SOM-GAN system

The SOM-GAN Rural Bank depositor's fund information security protection system proposed in this paper consists of five modules: information security monitoring module, information security management module, cloud storage module, information security guarantee module and information security appraisal module, and each module is composed of corresponding small units. The overall architecture diagram is as follows:

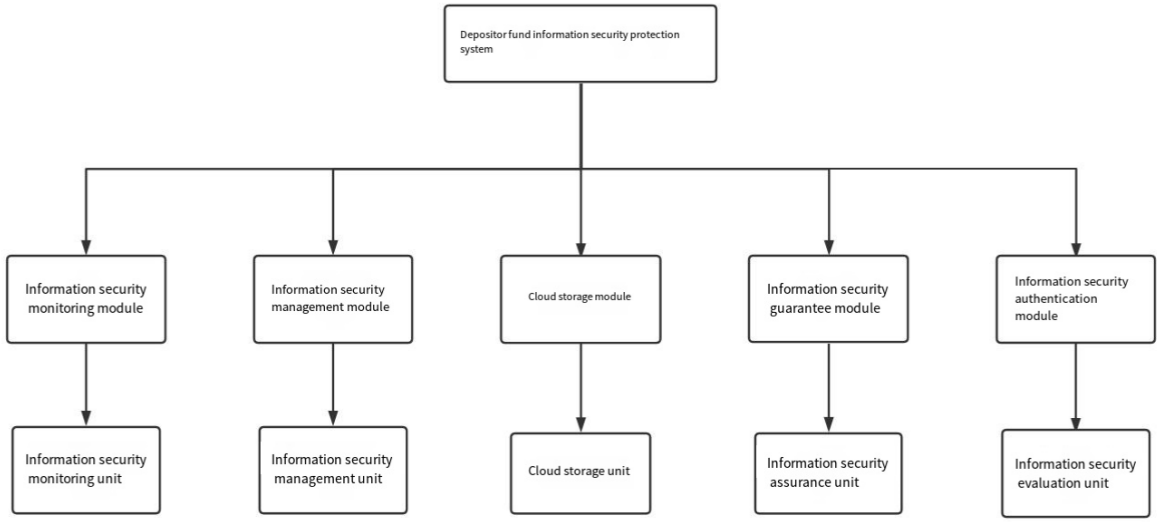

Figure 1. Model frame of SOM-GAN system

The system monitors when users store funds through the information security monitoring module, so as to ensure the security of users when storing funds. At the same time, the monitored data is transmitted to the cloud storage module, so as to provide data support for the follow-up. At the same time, the information security guarantee module ensures the security, confidentiality, authenticity and integrity of depositors' funds information. So as to effectively protect the security of funds information, but also can track it, and effectively lock the relevant responsibility contact personnel, at the same time through the information security identification module of the information security identification unit for the security of depositors' funds information is divided, so as to better remind depositors of the security of funds information, convenient for the first time to alert depositors.

4.2. Operation process of SOM-GAN system

a) The information security monitoring unit in the information security monitoring module shown in this system consists of a front-end image acquisition unit, a collection information transmission unit, a collection information storage unit, a control unit and other line units.

Through the front-end image acquisition unit of the information security monitoring unit, the depositor's actions during the storage of funds are collected, including the capture of actions and the monitoring of the surrounding environment, and then the data is transmitted to the collection information storage unit through the control unit to control the collection information transmission unit, which is convenient for the subsequent analysis of the surrounding environment when the depositor is storing funds. So as to ensure that it is carried out in a relatively safe environment to prevent plagiarism by others.

b) The information security management unit in the information security management module shown in this system includes the information security control unit, the information security execution unit and the information security supervision unit.

The scheme thoroughly analyzes the data transmitted by the information security monitoring unit through the information security control unit, the information security execution unit and the information security supervision unit, so as to ensure the safe and reliable storage of funds to the corresponding equipment.

c) The information security unit in the information security guarantee module shown in this system guarantees the security, confidentiality, authenticity and integrity of depositors' funds information.

d) The information security evaluation unit in the information security evaluation module shown in this system can be divided into low risk, medium risk and high risk levels for the security of depositors' funds information, and record it in the cloud storage unit.

The scheme measures the security, confidentiality, authenticity and integrity of depositors' fund information through the information security guarantee unit, and analyzes the funds themselves. When depositors are storing funds, they can be found at the first time when there are certain problems with their funds, thus reminding them to deal with the problems in their funds at the first time. At the same time, the information security identification unit can determine its risk level after the analysis, so as to remind the depositors in the first time.

4.3. SOM-GAN device component introduction

Based on SOM-GAN Rural Bank depositor's fund information security protection device, including depositor's fund information security processor and depositor's fund storage equipment. The depositor fund information security processor is connected with an information security monitoring component, an information security identification component, an information security guarantee component, an information security manager and a cloud storage server; The depositor's funds storage device comprises a depositor's funds access interface, a depositor's funds access port, a depositor's funds storage cabinet and a depositor's funds storage component. The specific work flow is as follows:

a) When the depositor deposits the funds into the fund access port through the operation access interface, the fund information security processor controls the information security monitoring component to monitor it and upload it to the cloud storage server;

b) The funds deposited in the fund access port are put into the fund deposit cabinet through the fund deposit component. When the fund deposit component is working, its information security processor controls the information security identification component to bundle and mark the funds; The information security processor controls the information security identification component to bundle and mark the funds, which can be marked by the way of user-bank docking staff;

c) After the bundled funds are stored in the cabinet, the information security component is used to analyze the security, confidentiality, authenticity and integrity of the funds information, and record and upload it to the cloud storage server.

In this scheme, the depositor controls the fund access interface when storing the funds, so that the funds are placed in the access port of the device, so that the funds are placed in the storage cabinet of the device through the fund storage component. During the corresponding actions, the depositor's fund information security processor can operate its corresponding components to carry out real-time monitoring and analysis of each step. So as to complete the supervision and protection of funds. The basic building block is shown in the figure:

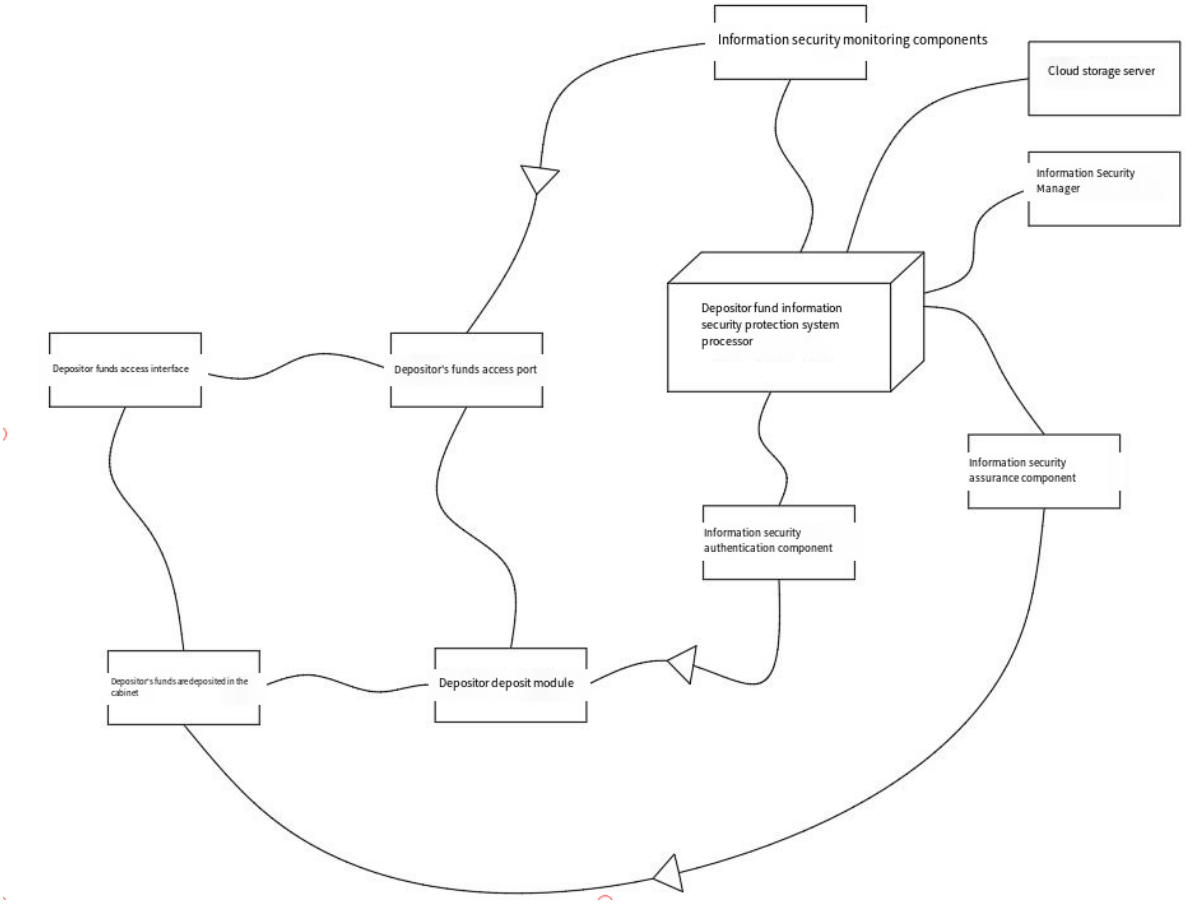

Figure 2. Basic building blocks of SOM-GAN device

4.4. Model training method based on SOM-GAN Rural Bank depositors' fund information security protection

The SOM-GAN model is established, and the SOM-GAN model includes an input layer and a competition layer. First, the input layer receives external information, and divides the input information samples into different regions, which have different response characteristics to different pattern samples, and then transmits the input pattern samples to the competition layer to play the role of "observation"; Then, through the competition layer, the input model samples are "analyzed and compared" to find the rules and classify them. By repeatedly inputting all the sample data into the network for training, the final weight will become stable.

The SOM-GAN model also includes a discrimination module and a generation module, through which the input information samples and output information samples are judged to be from the real sample set or fake sample set; By producing the sample module, the network can not judge the true or false of the sample.

5. Summary of advantages of SOM-GAN method

This scheme monitors when users store funds through the information security monitoring module, so as to ensure the security of users when storing funds. At the same time, the monitored data is transmitted to the cloud storage module, so as to provide data support for the follow-up. At the same time, the information security guarantee module ensures the security, confidentiality, authenticity and integrity of depositors' funds information. In order to effectively protect the security of the funds information, it can also be tracked, and can effectively lock the relevant responsible contact personnel. At the same time, the information security identification unit in the information security identification module is divided into the security of the depositors' funds information, so as to better remind the

depositors of the security of the funds information and facilitate the first alarm to the depositors. It provides a new idea for rural banks to improve the security protection of depositors' information.

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