



Research on Export Trade Information Sharing Method Based on Social Network Data

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Abstract. Export trade, also known as export trade, refers to the trading activities of selling domestic products or processed products to overseas markets. Due to the large amount of export trade information and the limited storage of resources, the utilization rate of resources is low and the ability of information sharing is poor. To this end, this paper proposes a method of export trade information sharing based on social network data. Through the distributed classification technology of the blockchain platform, we can access trade financing data and information in real time and establish an information service mode. Bayesian estimation is used for data fusion. Establish social network data communication links to transmit information resources. Federal learning algorithm is used to map the original data into the corresponding data sharing model to realize the sharing of export trade information. The test results show that the export trade information sharing method based on social network data can improve the detection rate and shorten the running time, so as to maximize the utilization efficiency of shared information, and achieve better information sharing effect.

Keywords: Social network data · Export trade · Information sharing · Communication resources · Sharing model · Data fusion

1 Introduction

The scale and competitiveness of foreign trade is an important manifestation of a country's economic strength, status and influence in the international economy, and it is also a basic indicator for measuring a trading power. After the global financial crisis, the global economic recovery is still slow, and the international trade situation is still complicated [1]. Social networking is the most popular and trending application on the Internet today. Can fully meet people's social needs [2]. The world economy is accelerating its transformation to an economic activity with the network information technology industry as its important content. Therefore, it is of great theoretical and practical significance to study the impact of social networks on the development of China's foreign trade in the current context.

Reference [3] proposes an interactive sharing method of medical image information based on local weighted fitting algorithm. The generalized feature points of the image are extracted by Moravec operator, and the initial matching relationship is established.

The local weighted fitting algorithm is used to add control points, and at the same time, these points are triangulated to ensure that each control point corresponds to a fitting result, and the image distortion points are corrected through the mapping relationship. The shared image is encoded by introducing semantic directivity and feature quantization, and the image is sent to the client. Introduce the above methods into the sharing system, determine the system functions from the main modules such as image source management and encoding format, and deploy the software scheme. This method can improve the throughput of the system, but the system runs for a long time. Reference [4] proposed the research on financial information sharing based on Improved SVM model. Using the correlation test method to test the initial characteristics of financial information, the important characteristics of financial information are determined. The improved SVM algorithm is used to build the financial information early warning sharing model. This method can improve the detection rate, but the algorithm is complex.

In order to solve the above problems, an export trade information sharing method based on social network data is proposed. Establish an export trade information service model and improve the efficiency of export trade information dissemination. Data fusion through Bayesian estimation to promote the conversion rate of trade scientific and technological achievements. Build an export trade information sharing model based on social network data distribution and communication resources, and improve the degree of industrial informatization.

2 Export Trade Information Sharing Method Based on Social Network Data

2.1 Export Trade Information Service Model

Under the influence of the new generation of information technology such as the Internet of things, the boundary between manufacturing and service industry has been broken. Their technical boundary, market boundary and business boundary are integrated into the manufacturing industry [5]. The scientific and technological services composed of information services, knowledge technology services and data services are internalized into the value components of the manufacturing industry. The basis for carrying out supply chain financing services and risk control must ensure the consistency between virtual information and real information, and the proof of transaction authenticity is required to be recorded in the creditor's rights information of the virtual world, and blockchain technology is a very suitable recording method. The Internet brings data agglomeration. As an important part of the new factor theory, big data is constantly being integrated into the production of enterprises. The information it generates can not only be exchanged, but also bring economic value. The high-speed information flow of the Internet increases the degree of openness of information, promotes the flow of factors, and brings together resources in various places, forming agglomeration of enterprises. The clustering of enterprises further promotes the emergence of regional industrial clusters, forms economies of scale, and reduces output costs. The formation of an effective scientific and technological information service mechanism can provide timely and systematic information on product scientific and technological achievements

for both sides of the trade, promote China’s informatization level, and solve the digital gap of export trade information.

2.2 Information Fusion Process Based on Social Network Data

For export trade information sharing, data fusion is the process of interaction between users and export trade information. Export trade data includes a large amount of user data, not only static data such as user basic information, but also dynamic data such as user behavior, which contains the information needs of users. Information in the network is transmitted from the dissemination end to the audience end at the speed of light, and the reliability is high. The current network technology can ensure that the information is almost error-free during the transmission process. The amount of content stored on the network is huge, and each piece of information has a large amount of repeated storage. The opportunities and times of forwarding and repeated dissemination of information increase exponentially. The process of data fusion is the process of sorting out and utilizing these data. The data fusion features are shown in Fig. 1.

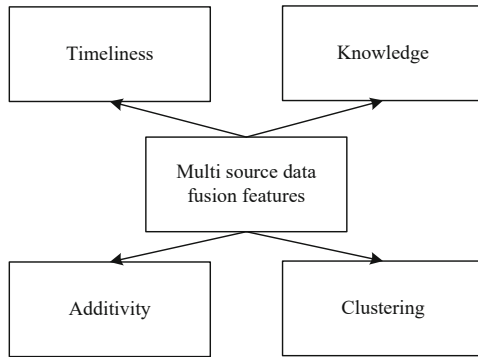


Fig. 1. Data fusion features

Data fusion is an automatic information processing method to assist decision-makers to make decisions and convert the collected information into processable representation values, so as to collect a variety of information sources. The process of data fusion involves many aspects such as data collection, processing, detection, combination and evaluation. After processing the data and fusing the data information, so as to accurately identify the state of events, the security degree of environment and the identity of participants. Data fusion can judge whether to allow the access operation requested by the user according to the constraints of policy and authorization attribute. If the authorization attribute of the user when making the access request does not meet the authorization attribute required in the corresponding policy of the requested access operation, dynamic authorization can assign the user less permission than the access operation requested by the user based on the policy requirements according to the authorization attribute already possessed by the user. In the traditional mode of information transmission, the disseminator and the receiver are fixed two different roles, but the receiver of information

transmission in the network can easily forward the received information, change the role from the receiver to the disseminator, and process and express their opinions. In the process of data fusion, massive data are sorted out, identifying corresponding knowledge, and deleting redundant and useless information, so as to obtain target state information. Most social network mining is based on the only relationship between any two nodes, but in fact, there are many kinds of relationships between them, and different relationships have different roles in specific tasks. In multi-level social network communities, the impact factors of different relationships are different under specific needs. The community mining of multi-level relationships can linearly combine different relationships, and the mining results obtained are more accurate and effective. In this paper, Bayesian estimation is used to fuse data. When fusing, the data should be as independent as possible. With independent partitioning, the system can be evaluated for decision using Bayesian estimation. The representation of the Bayesian formula is as follows:

$$w(p|q \cap r) = w(q \cap rp|p)w(p) \quad (1)$$

In formula (1), w represents the probability of making a decision; n represents the total number of decisions; p represents the decision condition; q represents the observation result; r represents the observation result under another source. There is a certain state at a certain moment, these states are recorded, and the whole information sharing system is updated in the form of feedback. Internet users can selectively and targetedly receive information, filter out information that they do not pay attention to and are not interested in, and are no longer passive recipients of information. Social network users may receive the same information transmitted by different friends for many times, forming n-to-1 transmission. After receiving this information for many times, if they are interested in this information, it will increase the credibility of the receiver, and even forward this information to spread the information again [6]. The multi-dimensional digital media resource provider provides the access control device with the multi-dimensional digital media resource, access rights and authorization attributes. The access control device is composed of a judgment module, an authority setting module and a control module. After the access control device obtains the resources, access rights and authorization attributes, the user can realize the self-restraint of the access rights by setting constraints on the basis of the obtained access rights [7]. Ontology-based situational modeling can reveal export trade information and their relationships more accurately. The reasoning rules are set in advance when recommending the rules based on the ontology, so as to discover the relevant relationship between the export trade information resources and recommend the trade information with a high degree of correlation to the users. When recommending, it is necessary to calculate the similarity of information resources. The formula is as follows:

$$\theta(z_1, z_2) = \frac{2 \log \alpha(z_1)\alpha(z_2)}{\log \alpha(z_1) + \log \alpha(z_2)} \quad (2)$$

In formula (2), z_1, z_2 represents two export trade information; α represents information entropy, which is the ratio of the number of times the information concept appears in the training set to the total number of the training set; θ represents the similarity. Data fusion expands components such as users, access rights, authorization attributes,

etc., and changes the way of information dissemination. The user initiates a resource access request through the access control device. The multi-dimensional digital media provider obtains the resource from the resource server according to the resource name, and obtains the access right from the authority server according to the name and the resource type. Linked data can solve the problem of data heterogeneity on the Internet, so as to save the data in the semantic web.

2.3 Allocating Communication Resources Based on Social Network Data

A social network can be defined as a social structure composed of many nodes, where the nodes are usually considered to be people or organizations, and the people in the social network contain various social relationships. Moreover, with the continuous development of mobile communication technology and the arrival of the era of big data, the society has shown a trend of becoming more networked, and the combination of people and the Internet has become closer. The social network uses the intelligent terminal as the carrier to identify the identity information of the social network user online, and realize various social activities through the data service of the mobile Internet network. In addition to the characteristics of traditional social network information release and group establishment, mobile social networks also have two distinctive features of location attributes and instant messaging. The locatability of mobile terminals enables mobile social networks to have location attributes. In the social network layer, each user can find a corresponding device in the physical network layer. In order to reduce the business burden of the base station and protect the user's personal privacy, users can request the content they need from other trusted users, or send the content directly or with the help of other users to the target user [8]. Node betweenness refers to the ratio of the number of all shortest paths in the network passing through the node, which is used to reflect the role, influence and status of the node in the network. Similar edge betweenness refers to the ratio of the number of all shortest paths in the network passing through the edge, which is used to reflect the role, influence and status of the edge in the network. At the social network layer, each content sent through a link is related to factors such as social relationships, social influence, and similarity between users. In particular, users with friendly relationships, such as users who trust each other, are more likely to establish communication links to transfer data. Only when the probability of the forwarder taking "dishonest forwarding" is less than the forwarding threshold set by the publisher, the forwarding is allowed; otherwise, the system will reject the forwarder's forwarding request. The history record obtaining module obtains the content and decision result requested by the forwarder to forward this time, and records them in the forwarding history record and threshold database. At the physical network layer, the physical communication history between users is collected, which is very helpful for discovering potential communication links. With the help of the base station, every mobile user can detect the neighboring devices in his vicinity at any time. Based on this information, the user is able to know the number of encounters he has with other users. Using the relevant theories of graph theory to study the structural characteristics of social networks, the most common research is to model social networks through graph structures. A graph $H = (G, K)$ is used to represent a social network, H represents a social network, G represents all users on the social network, and node $g \in G$ in the graph

is a user and an individual on the social network. $k \in K$ denotes that a link on a social network represents an association relationship. k reflects mutual trust between two users. The probability of two users meeting can be calculated by the following formula:

$$\beta_{xy}(\Delta\tau) = 1 - \frac{\min t_{xy}}{\Delta\tau} \quad (3)$$

In formula (3), β_{xy} represents the encounter probability of user x and user y within $\Delta\tau$ time; $\min t_{xy}$ represents the minimum encounter interval between user x and user y . Edges in a physical network graph can be represented by encounter probabilities. If the base station provides the mobile users with the encounter history information between the devices, each device can calculate the probability, or it can also be calculated at the base station and distributed to the corresponding users. Based on the analysis of the benefits of different game strategies selected by the forwarder and the publisher, combined with the historical data of forwarding operation, the probability of dishonest forwarding by the forwarder is calculated, and the final decision of whether to allow forwarding is given by comparing with the threshold set by the publisher. In order to ensure the successful transmission of data and minimize the transmission delay, the user will prefer to choose the equipment he can meet frequently as his relay. The data rate obtained at the relay node can be calculated by the following formula:

$$v = \frac{d}{2} \min\{\log_2(1 + \gamma_1), \log_2(1 + \gamma_2 + \gamma_3)\} \quad (4)$$

In formula (4), v represents the data rate obtained by the relay node selected by the user; d represents the bandwidth available to the user; γ_1 , γ_2 and γ_3 represent the signal-to-noise ratio of the relay node, the receiving node and the sending node, respectively. The final selected relay nodes not only maximize the achievable data rate, but also satisfy both social network and physical network constraints. The execution part is responsible for receiving the forwarder's forwarding request and executing the final forwarding control decision, and supports the publisher to set the forwarding threshold. The forwarding control part obtains the forwarding control decision by executing the relevant algorithm and records the current forwarding content and the forwarding decision of the forwarder in the forwarding history and threshold database [9]. In this way, an export trade information communication network is established with the goal of maximizing the data rate of each node.

2.4 Establish Export Trade Information Sharing Model

Multi-party data sharing is an effective way to alleviate the problem of limited computing and storage resources. In distributed multi-party application scenarios, the risk of data leakage brought by centralized servers is even more significant. Social network registered users who initiate access control effect evaluation upload resources such as texts, pictures, and videos through social networks and formulate their access control policies. To sum up, there are two main obstacles in the current data sharing: first, the centralized management server needs to process a large amount of data from different participants, including some unknown new data; Second, these participants do not fully

trust each other (including the management server), and each participant will worry that the data they share will be leaked to other unreliable participants. The existing access control methods based on relationship and game theory only restrict the access operation of resources in social networks, and can not tell users whether the access control policy is appropriate. Inappropriate access control policies will bring serious consequences to resource publishing users, and even threaten the security of themselves and their families. This paper establishes an export trade information sharing method. The new sharing mechanism does not provide the original data, but uses the federal learning algorithm to map the original data to the corresponding data model. It is assumed that all parties involved in export trade information sharing have registered by uploading data retrieval information to the licensing blockchain. The export trade information sharing model established in this paper is shown in Fig. 2.

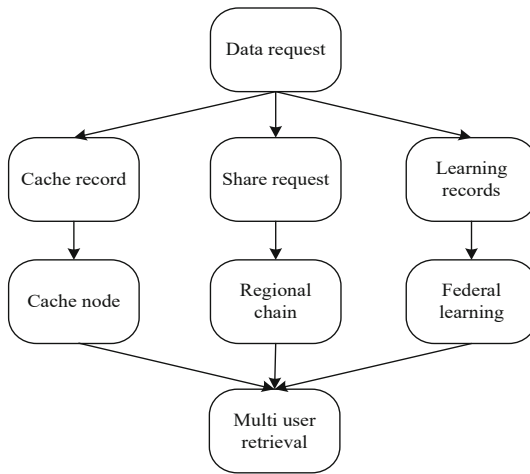


Fig. 2. Export trade information sharing model

When the data requester initiates a sharing request, it sends the request to the super node near it in the licensed blockchain network. The super node first searches the blockchain record to determine whether the request has been processed before. If there is a hit record in the search result, the previously cached calculated data model will be returned directly to the requester. The history includes the resources uploaded by the social network registered user who initiated the access control effect evaluation and the access control policies set for the resources. If there is no cached result, the super node searches for the relevant node of the blockchain for the sharing request through the aforementioned multiple data retrieval processes, that is, the “committee node” of the blockchain. The committee nodes are responsible for implementing the consensus protocol and collaboratively learning the federated data model. The execution part is responsible for receiving the user’s evaluation request, calculating the final evaluation result, and allowing the user to modify the access control policy according to the evaluation result. The Laplace mechanism is applied to the local export trade information

data to achieve differential privacy. The calculation formula is as follows:

$$\varpi' = \varpi + L\left(\frac{\mu}{\chi}\right) \quad (5)$$

In formula (5), ϖ and ϖ' represent the local export trade information data before and after the update respectively; L represents the Laplace mechanism; μ is the sensitivity value in differential privacy; χ represents the privacy budget. μ can be calculated using the following formula:

$$\mu = \max\|\phi(a) - \phi(b)\| \quad (6)$$

In formula (6), a and b represent two adjacent data sets with at most one different data record; ϕ represents the query result. The entire model is trained across distributed export trade information data providers. Sharing behavior shows weak anti-memory, publishing behavior is easy to be followed by a short time interval after a long time interval, and a short time interval is easy to be followed by a relatively long time interval. The membership node calculates the corresponding local data model for the request sent by the requester, and then forwards the data request to other relevant participants according to its local retrieval table. This process is repeated for all relevant parties until all relevant parties have been traversed. The trained data model cycles are returned to the requester as a response to their data sharing request. The receiving module obtains the user's evaluation request, including information about the social network resource requested for evaluation, and provides the information to the evaluation part. The execution module receives and displays the evaluation result provided by the evaluation part to the user, and at the same time allows the user to modify the access control policy according to the evaluation result. Data sharing events between data requesters and data providers are generated in the form of transactions and broadcast in the permissioned blockchain. All records are collected into blocks by blockchain nodes and cryptographically signed accordingly. The consensus mechanism is executed by the relevant nodes selected by the aforementioned multi-party retrieval. The user history acquisition module requests relevant history records from the history database according to the evaluation request and related information provided by the execution part, including resources uploaded to the social network and corresponding access control policies. The keyword generation module generates keywords according to social network resources. The relationship acquisition module acquires the relationship between the user and all the friends in the friend list from the social network relationship graph. The node that wins the competition broadcasts its locally newly generated block to other nodes for verification. After verification, the block is added to the permissioned blockchain. Block records are immutable after being added to a permissioned blockchain. So far, the design of the export trade information sharing method based on social network data is completed.

3 Experimental Studies

3.1 Experiment Preparation

The experiments in this section validate the proposed secure data sharing method on two real datasets, which are widely used to evaluate text-related machine learning algorithms.

The Reuters dataset is a benchmark dataset for classification tasks. Another 20 news groups dataset is a collection of about 20,000 short documents. The data in both datasets are unstructured short text data, which is very different from the structured data in the database. Preprocess each piece of basic data to obtain a four-dimensional vector of eigenvalues and a Boolean-type target value, which together correspond to a piece of training data. The processed 120,000 pieces of training data constitute the training sample set. This experiment uses these two datasets to simulate a large number of unstructured short data fragments in export trade information. This experiment divides the sorted dataset into slice sets and reassembles the slice sets into data subsets to simulate a distributed scenario of multiple export trade transactions. The experimental environment is as follows. CPU: Dual Core i7-3770, 3.4 GHz; RAM is DDR 8 GB; HDD is 500 GB, 7200 r; OS is Windows 10. The programming language is Python 3.5.2 (64-bit); the simulation software is Matlab 7.11.0.

3.2 Results and Analysis

This paper selects the detection rate and running time of information sharing as the test indicators, and trains the export trade information sharing method based on social network data proposed in this paper on the Reuters data set and the 20 newsgroups data set. The detection rate and time consumption results of the method in this paper are compared with the export trade information sharing methods based on random forest and SVM to verify the advantages of the sharing method in this paper. The detection rate results are shown in Tables 1 and 2.

Table 1. Comparison of detection rates on Reuters datasets

Testing frequency	The proposed method	The method of reference [3]	The method of reference [4]
1	0.926	0.886	0.856
2	0.938	0.855	0.878
3	0.945	0.861	0.851
4	0.922	0.854	0.834
5	0.913	0.842	0.827
6	0.936	0.863	0.842
7	0.949	0.858	0.813
8	0.955	0.827	0.823
9	0.922	0.804	0.815
10	0.931	0.821	0.807

In the training of the Reuters dataset, the detection rate of the proposed method is 0.934, which is 0.087 and 0.099 higher than the methods of reference [3] and [4].

Table 2. Comparison of detection rates in the 20 newsgroups dataset

Testing frequency	The proposed method	The method of reference [3]	The method of reference [4]
1	0.941	0.826	0.846
2	0.947	0.849	0.856
3	0.954	0.835	0.867
4	0.968	0.853	0.854
5	0.962	0.866	0.831
6	0.956	0.858	0.818
7	0.943	0.842	0.822
8	0.975	0.871	0.820
9	0.953	0.834	0.833
10	0.952	0.855	0.859

In the training of the 20 news groups dataset, the detection rate of the proposed method is 0.955, which is 0.106 and 0.114 higher than the methods of reference [3] and [4]. Therefore, the export trade information sharing analysis proposed in this paper has strong scalability, and the detection rate is improved compared with other sharing methods. The run time results are shown in Tables 3 and 4.

Table 3. Running time comparison of Reuters dataset (ms)

Testing frequency	The proposed method	The method of reference [3]	The method of reference [4]
1	856	979	1084
2	862	988	1247
3	872	966	975
4	859	925	956
5	860	1054	1062
6	888	1107	1125
7	826	1211	1051
8	853	1042	1198
9	875	1153	1262
10	817	1025	930

In the training on the Reuters dataset, The running time of the proposed method is 857 MS, which is 188 MS and 232 MS higher than that of the methods of reference [3] and [4].

Table 4. Comparison of running time of 20 newsgroups dataset (ms)

Testing frequency	The proposed method	The method of reference [3]	The method of reference [4]
1	816	1096	982
2	808	1056	962
3	824	1182	1095
4	835	965	1158
5	813	937	1126
6	802	1054	1039
7	841	1021	1152
8	827	910	1070
9	835	943	941
10	812	978	1017

In the training on the 20 newsgroups dataset, The running time of the proposed method is 821 MS, which is 193 MS and 233 MS higher than the methods of reference [3] and [4]. The running time of the shared method in this paper is slightly shorter than that of the two contrasting methods. The participation of multiple data providers expands the scale of data used for computation, thereby making the content of data sharing more accurate and improving the quality of applications.

In order to test the memory occupancy of the three methods, 1000 data were randomly selected in the 20 newsgroups dataset for experiments. The test results of the three methods are compared, as shown in Fig. 3.

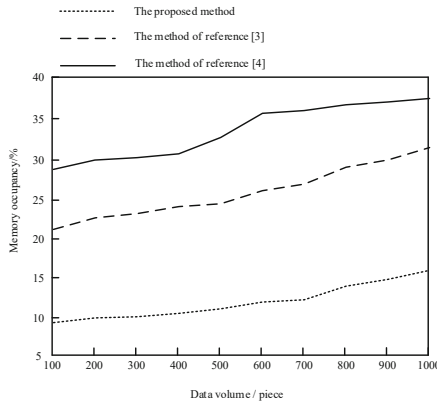


Fig. 3. Comparison of memory occupancy of different methods

As can be seen from Fig. 3, in the 20 newsgroups dataset, the memory occupation rate of the proposed method is 821\,ms. The memory occupancy of the method of reference

[3] and the method of reference [4] are 193 MS and 233 MS respectively, which are higher than the proposed method. It is proved that the information sharing effect of the proposed method is better.

4 Conclusion

Network development not only provides many traditional foreign trade enterprises with opportunities to expand market business and improve service levels, but also provides many small and medium-sized enterprises with an effective way to enter the foreign trade market. Taking advantage of the network opportunities can realize the advantages of China's trade in services, thereby promoting the coordinated development of trade in goods and trade in services. This paper proposes an export trade information sharing method based on social network data. Combined with the comprehensive consideration of detection rate and time consumption, the method utilizes limited communication and computing resources, maximizes the utilization efficiency of resources through reasonable allocation, and improves the sharing performance. Considering the subjectivity of users setting the degree of information privacy, in order to obtain more accurate evaluation results, it is proposed to use machine learning algorithms to classify transaction users, and then use machine learning algorithms to evaluate the effect of shared access control for different categories of users.

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