Modeling and Forwarding Prediction of Social Network Information Transmission

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Abstract. With the continuous progress of network information, the traditional way of information transmission is replaced by social network, and gradually become an important way for people to obtain various types of information. In social networks, network users can spread and receive information to the maximum extent within a reasonable range and conduct interpersonal communication on this basis. The basic data of social network is generated by the original information published by network users, and the transmission of basic data is realized through the forwarding of other users, that is, the effective transmission of social network information. The purpose of this paper is to predict the trend and law of network information dissemination by means of modeling and forwarding prediction of social network information dissemination, so as to promote the positive role of information dissemination. In this paper, the relevant definitions involved in social network are analyzed. On this basis, PCA algorithm is used to accurately analyze the network information data. Then, specific analysis is made on the establishment of the transmission model. The experiments in this paper show that the establishment of the social network information dissemination model is conducive to promoting the accurate prediction of information dissemination and realizing the positive dissemination of network information.

Key words: Social Network, Propagation Model, Forward Prediction, PCA Algorithm

1. Introduction
At present, with the development of network information technology, China has stepped into the information age. With the advent of the information age, various types of social networks have been rising rapidly, mainly represented by microblog and WeChat. This kind of social network is very different from the traditional social network. It is a virtual community based on information technology, which can help network users to exchange and share information quickly. At present, social network has gradually become a synonym of the information age and has exerted a profound influence on People's Daily life. Through consulting relevant materials, it is found that China's social
network platform is still growing in a straight line in recent years, and the development trend is still in a good state.

The prominent feature of the rise of social networks is the change in the mode of information transmission, which not only enables information transmission to achieve high speed, but also greatly increases the channels and scope of information transmission [1]. On the one hand, it is beneficial to realize the global information sharing, on the other hand, it also brings many problems. Based on this situation, people's attention to the information of social networks is increasing and has also attracted extensive attention from scholars at home and abroad [2-3]. At present, scholars at home and abroad have made a series of researches on social network information and obtained many research results. Research focused on the present situation of network information transmission, network information transmission mechanism and the influencing factors of network information transmission, etc., through access to relevant information can be found these studies are mainly on a specific network information transmission, no comprehensive research results, the lack of integrity of research on network information spread, especially in the social network information dissemination on the forward modeling and prediction research also has many insufficiencies [4-5]. Therefore, from this point of view, there is still a lot of room for improvement.

In order to promote the further development of the research, in this paper, the social network involved in the related definitions are analyzed, based on the accurate analysis of the network information data with PCA algorithm, and then gives a detailed analysis to the establishment of a transmission model, finally, on the basis of model for network information forwarded to accurately predict [6-7]. The innovation of this paper lies in paying attention to the whole network information transmission, grasping the information transmission concerns and effectively realizing the accurate grasp of forwarding prediction. The research in this paper is of great practical significance. It not only summarizes the information dissemination of social networks, but also realizes the in-depth combination of network users' activities and information dissemination models. It is also conducive to guiding the correct public opinion and promoting the harmonious development of society [8-9]. On the one hand, it promotes the research on the modeling and forwarding prediction of social network information transmission and enriches the theoretical connotation. On the other hand, it provides a certain theoretical basis for future relevant studies [10].

2. Method

2.1 Social Networks and Information Dissemination
Social network is a virtual community established on the basis of information technology, which can help network users quickly realize information exchange and sharing [11]. Social network provides a convenient channel and a new way of information dissemination, effectively reducing the cost of information exchange. At present, social network has deeply affected People's Daily life style. In China, WeChat, QQ, weibo and other typical social network platforms are the representatives [12-13]. The coverage of social network is very extensive, basically including all forms of social network services, has been infiltrated into schools, business, scientific research and other fields. In general, there is a close relationship between social network and information transmission. The most prominent thing that social network produces is that it changes the way of information transmission and promotes the speed and scope of information exchange. On the one hand, social network has a favorable influence on information dissemination; On the other hand, the spread of bad information is not conducive to the correct guidance of public opinion [14-15]. Information transmission has a certain model, which is mainly used to describe the process of information transmission in social networks.

2.2 PCA Algorithm
The full name of PCA algorithm is PCA principal component analysis algorithm. The principal component analysis algorithm can effectively solve the complicated problem caused by too many
dependent variables and realize the effective extraction and management of important data information. PCA algorithm can reduce the dimensionality of the data with multidimensional characteristics to form a new set of data vectors under the condition of ensuring information integrity. In other words, a positive change is carried out on the basis of the original data information to produce the orthogonal mapping on the lower dimensional space. The purpose of this algorithm is to simplify the problem solving by data transformation and make the data closely related. Therefore, this algorithm has obvious operational advantages, which not only guarantees the integrity of data information, but also can conduct comprehensive and effective analysis of data, simplifying the analysis process of data information. The algorithm first needs to construct the initial data matrix, that is, extract the data sample \( m \) from the sample set, and each sample contains a total of \( n \) dimensions. Then, the resulting data matrix \( M \) is expressed by the following formula:

\[
M = (m_1, m_2, m_3, ..., m_n)
\]  

After the initial matrix is established, it should be standardized and covariance calculated to obtain the characteristic points and parameters of the matrix, so as to determine the principal components in the sample. The principal component obtained in this paper is the key factor influencing the construction of network information transmission model. The higher the contribution rate of the principal component is, the greater the influence of this factor is. Finally, the principal component components are recombined to form the forward mapping function mentioned above, that is, the function expression required for model establishment. The specific formula of the function is as follows:

\[
Z_i = \alpha_1m_1 + \alpha_2m_2 + \alpha_3m_3 + ... + \alpha_m m_n
\]

Where, \( Z_i \) represents the attributes of the original data sample; \( I \) is the coefficient of the principal component in order \( I \), and \( m_i \) is the value of the principal component in order \( I \).

3. Establishment of Information Transmission Model and Simulation Experiment

Based on the information propagation model before the establishment of access to a large amount of data, the article analyzes the related research data, combined with the characteristic of social networks and information dissemination mechanism, established accord with the characteristics of social network information transmission SEIR - Pro information transmission model, this model conforms to the principles of the truth of social networking. The model mainly includes transmitter, receiver, lurker and immunizer nodes. The flow diagram of seir-pro model describes the whole information transmission process in detail. There are a variety of parameters in this model, where \( S \), \( E \), \( I \), and \( R \) represent recipient, lurker, transmitter, and immunizer nodes, respectively. Lambda represents the probability per unit time between the receiver and the lurker node, \( a \) represents the probability per unit time between the lurker and the transmitter node, and \( 10 \) represents the number of valid information nodes. Represents the probability per unit time that the transmitter converts to the immunizer node, represents the probability per unit time that the receiver converts to the immunizer node, and represents the probability per unit time that the lurker node converts to the immunizer node.

After the establishment of the information transmission model, simulation experiments should be carried out to test the reliability of the model. In the detection process of this model, the key is to analyze the transformation law of each state node in the model. With the help of PCA algorithm, the network information forwarding can be predicted accurately by analyzing the transformation law of nodes in different states.

4. Discuss

4.1 Experimental Results and Analysis

Through the establishment of the above information transmission model and relevant simulation experiments, we can draw the conclusion that seir-pro information transmission model is conducive to
the realization of the law of information transmission, and accurate network information forwarding prediction can be achieved by analyzing the law of node transformation in each state. The specific experimental data are shown in figure 1 and table 1 below. The data in the chart is the result of the author's experimental arrangement.

**Figure 1.** Analysis of success rate of information transmission

**Table 1.** Behavior prediction index system

| Characteristics of the category | Serial number | Indicators           | Precision | Recall rate | F1 |
|---------------------------------|---------------|----------------------|-----------|-------------|----|
| Attributes                      | 1             | Number of fans keywords | 87.54%    | 12.41%      |    |
|                                 | 2             | Number of people      |           |             |    |
|                                 | 3             | Date of birth         |           |             |    |
|                                 | 4             | Sex don't             |           |             |    |
| Behavioral attributes           | 5             | Number of posts       |           |             |    |
|                                 | 6             | Forwarding number     |           |             |    |
|                                 | 7             | Remind the number     |           |             |    |
|                                 | 8             | Comment number        | 86.79%    | 11.47%      |    |
|                                 | 9             | Comment number        |           |             |    |
|                                 | 10            | Forwarding activity   |           |             |    |
|                                 | 11            | Comment activity      |           |             |    |
|                                 | 12            | Alert activity        |           |             |    |
|                                 | 13            | Release activity      |           |             |    |
| Interest in the property | 14 | Label similarity | 90.06% |
|--------------------------|----|------------------|--------|
|                          | 15 | Number of classification keywords | 11.21% |
|                          | 16 | Classification keywords similarity | 2      |

*Data came from the in-depth analysis of financial data in the experiment*

According to figure 1, we can find that by establishing the data model of information transmission, we can master the law of information transmission. According to the data found in Table 1, the forwarding behavior factors were extracted with the help of PCA algorithm for principal component extraction, and the main factors of three forwarding behaviors were obtained, namely, feature attributes, behavior attributes and interest attributes. As shown in Table 1, feature attributes are only affected by their own factors, so they can be calculated separately from the other two factors. Behavior attribute is the reflection of a series of activities carried out by users in social network, mainly reflecting the active degree of users in social platform. The function of interest attribute is to analyze the similarity between different users, which is mainly reflected in the information published and disseminated by users.

### 4.2 Prediction of Network Information Forwarding

Through the above experiments and the data in Table 1, we can see that the important factors affecting network information forwarding mainly include feature attributes, behavior attributes and interest attributes, each of which corresponds to a variety of indicator types. Therefore, the prediction of network information forwarding must be based on in-depth analysis of these three attributes. In this paper, data mining is used to carry out in-depth mining of network information forwarding data, so as to evaluate scientific forwarding prediction ability. The main dimensions include accuracy, recall rate and F1 score method. The accuracy is mainly used to predict the behavior of forwarding users and the proportion of forwarding users. The recall rate represents the overall percentage that can be mispredicted; The formula 1 value comprehensively considers both accuracy and recall rate. It can be seen from the above chart that different attributes have different effects on the prediction of network information forwarding. From the data in Table 1, it can be seen that the above three attributes have a high to low influence on the forwarding result, namely, behavior attribute, characteristic attribute and interest attribute. Among them, the low influence of interest attribute on forwarding prediction result is caused by the change of interest, and the specific forwarding content of users will change with the change of interest.

### 5. Conclusion

Information dissemination on social networks has a profound impact on all aspects of life in the information age. In-depth research on information dissemination modeling and forwarding prediction on social networks is conducive to the positive development of information dissemination, which minimizes the negative impact of information dissemination and is conducive to the harmonious development of society. This paper proposes a accord with the characteristics of social networks and information dissemination SEIR - Pro information transmission model, in this paper, the experiment proves that the establishment of the social network information transmission model to achieve mastery of information propagation law, through the analysis of the condition node transformation rule can realize network information forward projections for accurate.

### Reference

[1] LI Jinjie, WU Lianren, QI Jiayin. Research on Information Dissemination in Online Social Network Based on Human Dynamics[J]. Journal of Electronics & Information Technology, 2017, 39(4):785-793.
[2] Xu Baoda, Zhao Shukuan, Zhang Jian. Research on Information Dissemination of Official Accounts in WeChat Based on Social Network Analysis[J]. Journal of Intelligence, 2017, 22(5):117-121.

[3] Luarn, Pin, Yang, Jen-Chieh, Chiu, Yu-Ping. The network effect on information dissemination on social network sites[J]. Computers in Human Behavior, 2017, 37(15):1-8.

[4] Erez Yaakobi, Jacob Goldenberg. Social relationships and information dissemination in virtual social network systems: An attachment theory perspective[J]. Computers in Human Behavior, 2017, 38(13):127–135.

[5] Fang, Binxing, Jia, Yan, Han, Yi. A survey of social network and information dissemination analysis[J]. Science Bulletin, 2018, 59(32):4163-4172.

[6] Zhang, Bo, Xiang, Yang. Trust-Aware Information Dissemination in Social Network[J]. Applied Mechanics & Materials, 2017, 12(9):121-126.

[7] Zhang YanChao, Liu Yun, Zhang HaiFeng. The research of information dissemination model on online social network[J]. Organic Chemistry Frontiers, 2017, 60(5):114-117.

[8] Yaakobi, Erez, Goldenberg, Jacob. Social relationships and information dissemination in virtual social network systems: An attachment theory perspective[J]. Computers in Human Behavior, 2017, 38(14):127-135.

[9] Ru-Zhi Xu, He-Li Li, Chang-Ming Xing. Research on Information Dissemination Model for Social Networking Services[J]. International Journal of Computer Science & Application, 2017, 2(1):1-6.

[10] Lima, A, De Domenico, M, Pejovic, V. Disease Containment Strategies based on Mobility and Information Dissemination[J]. Scientific Reports, 2018, 5(1):10650.

[11] Samaddar, Subhajyoti, Murase, Makoto, Okada, Norio. Information for Disaster Preparedness: A Social Network Approach to Rainwater Harvesting Technology Dissemination[J]. International Journal of Disaster Risk Science, 2018, 5(2):95-109.

[12] Gina Lai, Odalia M. H. Wong. The Tie Effect on Information Dissemination: The Spread of a Commercial Rumor in Hong Kong[J]. Social Networks, 2017, 24(1):49-75.

[13] Jie Hu, Lie-Liang Yang, H. Vincent Poor. Bridging the Social and Wireless Networking Divide: Information Dissemination in Integrated Cellular and Opportunistic Networks[J]. IEEE Access, 2017, 3(24):1809-1848.

[14] YI Chengqi, BAO Yuanyuan, XUE Yibo. Research on Mechanism of Large-Scale Information Dissemination Based on Sina Weibo[J]. Journal of Frontiers of Computer Science & Technology, 2017, 7(6):551-561.

[15] Qing Yang, Binhai Zhu, Shaoen Wu. An Architecture of Cloud-Assisted Information Dissemination in Vehicular Networks[J]. IEEE Access, 2018, 4(9):15.