

Research Article

News Hotspot Event Diffusion Mechanism Based on Complex Network

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The wide range of social hot news events on the Internet has made the Internet have a great impact on the public. However, there are few studies on Internet information. In order to improve the efficiency of user network information dissemination of Internet information based on complex network theory and model simulation, this paper makes a more in-depth study on information dissemination on the Internet, constructs a complex network of Internet information dissemination, and analyzes the static topology and dynamic evolution process of the network. Using the attention relationship between Internet users, the Internet information dissemination network, degree, and path were used to select multiple indicators. The static topology of the network is analyzed by using the complex network theory. The study found that the complex network of Internet information is different from other complex networks. The influencing factors of network dynamic evolution are studied from three aspects: overall structure, local structure, and time constraints. The evolution trend of different forms and overall network nodes in the evolution process was explored, and the network dynamic evolution process model was constructed. Practice shows that the model can better describe the evolution process of network information dissemination in complex networks. The degree values of the two networks are positively correlated with the corresponding average clustering coefficients, and the networks have a significant hierarchy. The correlation between news hot events and network nodes is not as good as users' attention to the network.

1. Introduction

Now is an era of information, and we are exposed to a lot of information every day. With the continuous advancement and evolution of the network media, the Internet has become an important information exchange platform, and the traditional information interaction is changed [1]. The emergence and popularization of the computer Internet quickly brought humans into the information age. The development of informationization has far exceeded human imagination, and new civilization results have quickly spread, and social industrial structure, values, and organizational forms continue to be informal and subversive. Information gradually became the main wealth of society. We are in a transformation phase mainly based on material production and consumption. People are not only the communicator of the

information but also the manufacturer of information, the content of information is more diverse, and the time of information transmission is more fragmented [2]. By mining and discovering the law of Internet information dissemination, we can deeply understand the nature of people's information interaction, providing a theoretical basis for Internet marketing and public opinion monitoring [3]. The application mode of network information acquisition is subdivided into network news mode, search engine mode, information classification mode, information aggregation mode, and knowledge sharing mode; e-commerce application mode is subdivided into B2B e-commerce mode, B2C e-commerce mode, C2C e-commerce mode, and o2o e-commerce mode. The application mode of network communication and interaction is subdivided into an instant messaging mode, personal space mode, network social

networking mode, and network forum mode. The application mode of online entertainment is subdivided into online game mode, online literature mode, and online video mode.

This paper combines the theory of complex networks, and the overall analysis of the information communication of the Internet environment, including the analysis of the network structure of the Internet information communication network, the characteristics and evolution laws of Internet information propagation, analysis of Internet information propagation paths and time characteristics, and the measure of the ability to transmit the user information was performed. However, through the related literature research, the theory is generally analyzed from the perspective of communication and marketing. It is mainly based on the characteristics, effects, and meaning of the Internet through communication. Most of them are also limited to qualitative analysis; fewer people use quantitative, empirical analysis methods and study the features of the network structure and information propagation of the Internet through related propagation models [4].

This paper first analyzes the network characteristics of the Internet by analyzing the research results of the literature related to the Internet and complex network theory. On the basis of describing the actual Internet information propagation process, the propagation model of the typical infectious disease model is used to establish the information propagation model in the Internet network [5]. Finally, the process of model information propagation is simulated by simulating the simulation method, and the simulation results are analyzed. Combining the user network structural characteristics of the Internet, obtaining the network characteristics of the Internet users, and verifying whether the network has typical complex network features by calculating the complex network theory statistics of the Internet were performed. Drawing on the propagation idea of the typical infectious disease model, information on the communication characteristics and communication laws in the Internet network was studied, and the conversion rules between the status of nodes and states were designed to build a complex network-based Internet information propagation model [6].

2. Related Work

At present, the Internet has been widely studied by scholars, but most studies are related to the identification of public opinion information on the Internet and the excavation of users concerned, and very few are related to network structures and discussion of the network structure formed during the spread of public opinion on the Internet. Therefore, the network growth process of public opinion information in the Internet network was studied, and the network structure formed was analyzed, and then how to control and guide public opinion was analyzed, which is very important and practical and will help design the corresponding mechanism to network public opinion. The propagation process is guided and controlled.

Nian et al. have a conceptual model, which comprehensively reveals the reasons for consumers using the network. The study believes that the factors that affect users' use

of network are perceived demand, user innovation, innovation features perception, and perception of network popularity. User-aware requirements include entertainment, information society interaction, self-performance, hair transmission time, professional enhancement, and new trends; the perception of network innovation features includes network relative advantages, network content, consumer values, and experience and need matching the complexity of sex, network use, the degree of trial, and the visibility of the results [7]. Xu et al. propose a web keyword extracting algorithm based on a band-right language network. The impact of various types of HTML tags on the web page has the degree of intensiveness of the text content as a continuous weight, on this basis. Methods of dielectric numbers and tightness two-parameter weighted methods define the integrated center of the node as a synthetic feature value of nodes [8]. Duari and Bhatnagar proposed a Chinese document keyword extracted algorithm based on complex network characteristics. On the basis of universal unrequites, the integrated feature value of the node is used to use the node value and the cluster coefficient of two parameters. They think the degree value of the word. The more important the word, the more important words, and the cluster coefficient of the words is closely related to the local connection of the words, whereby the keywords extracted are often the central role in the module [9]. Gavric and Bagtasaryan propose an improved small-world model, and the improved small-world model is actually a stack of rules and random networks. It uses "random addition" instead of "random reunion" in the small world model. In the small-world network, due to reunion, it may cause the problem of generating an isolated point in the network [10]. Liu proposed another model of the WS small-world model. The model adds nodes in the middle of the ring and is randomly connected with the nodes in the grid. The "remote connection" acting as a node in the WS model has contributed to the further study of the characteristics of the small world [11]. Based on the two-dimensional square, Jain et al. proposed the general model of the WS small-world model. Yangbo et al. put forward the small-world network model based on individual choices [12]. Dong and Cao proposed a small-world network model based on a geographic choice of optimal connection mechanism [13]. Zhang and Pan studied the spread critical value of a limited scale-free scale network and found that the limited scale-free scale network also has a vulnerability to viral propagation [14]. Zhao et al. studied the propagation critical value characteristics of the associated network and discovered that the range of viral propagation in the associated network is small to the range of non-associated networks under the same distribution. The network is susceptible to viral attacks to cause viruses, so people have studied the scale network [15]. Nie et al. proposed to explore the enterprise and consumer group in the social network space. The dynamics mechanism of communication and the role of consumers in the network is to create a kind of competitive environment, thereby driving enterprises into the innovation process. In the network exchange between consumers and enterprises, innovation appears in the form of relational products [16]. Chen et al. make compared

analysis of Twitter content and traditional news media, using Twitter-LDA models and text mining technology to compare Twitter and New York Times and discovered Twitter's communication combat more [17]. Sun and Sheng summarize the network structure and information dissemination research of online social networks and summarize the three main aspects of online social network information communication research, namely, the information transmission model, information transmission root, and the discovery and portrait of the information propagation path and how to achieve the maximum and minimalization of online social network information [18]. Austin and Yan combined the principle of infectious disease, proposing an online social network information communication model, studied the characteristics of different online social network user behaviors, established and simulated the online social network information dissemination process, discoverable information communication coefficients and the larger the immune coefficients, the faster the information spread, the faster state, and the behavior characteristics of different types of online network users in the information dissemination are different [19].

In summary, there has been much research on information communication on online social networks in recent years. The main reason is that online social networks have a large scale, anonymous, dynamic, and interactive content. The degree changes the way of human information communication. It is particularly worth noting that research starts from the perspective of the network model and information propagation model in terms of information dissemination research on Internet environments. However, the research on information dissemination of the news hotspot event is only limited to the level of the information propagation network from the single original Internet, and the mining research of the information propagation rules exhibited in the selected particular population is still relatively small.

3. Complex Network Theory

3.1. Complex Network Structure Statistical Indicator. Many complex systems can be modeled as a complex network for analysis, such as common power network, aviation network, transportation network, computer network, social network, and so on. A complex network is not only a form of data but also a means of scientific research. In fact, the scale-free characteristics of complex networks are closely related to the robustness analysis of networks. The existence of power law distribution in the network greatly improves the possibility of the existence of height number nodes. Therefore, the standard free network shows the rudeness against random faults and the vulnerability against deliberate attacks at the same time. This robustness and vulnerability have a great impact on network fault tolerance and antiattack ability.

The network includes two basic elements: the connection between nodes and nodes. The system in the real world has specific functions and structures, which are combined by several parts, and these parts are interacting and interdependent. If each component of the system is considered a

node, the node is constructed according to the connection relationship between components. The network can be used to describe the system in which the system is described. Complex networks are highly abstract and summary of a large number of real systems in nature, and there is no strict definition, but according to the research on complex networks at home and abroad, the following three protruding features can be summarized: first, the network of complex networks is large and the network behavior has statistical significance; second, complex networks are neither a complete rule is not fully random but have self-organization ability; third, complex networks continue to evolve with time and space [20]. The network effect caused by the reverse activity measured by the conventional analysis method is difficult to predict accurately. Heuristic detection and artificial intelligence technology may help. In this paper, an agent-based framework is matched with the dynamic configuration of the network algorithm based on automation, supply chain configuration, and performance improvement in an advanced supply chain.

After nearly more than ten years of rapid development, scholars put forward dozens of complex network structural statistical indicators, and the most basic three indicators were the average path length, cluster coefficient, and degree distribution map. The average path length is the average of the distance between the two nodes in the network, which is the main indicator of the network on a global scale [21]. Assume that the distance d between the nodes i and j is connected to the shortest path of the two nodes, the number of network nodes is N , and the average path length L of the network can represent (1).

$$L = \frac{1}{1/2N(N+1)} \sum_{i \geq j} d_{ij}. \quad (1)$$

The degree distribution of nodes in the random network follows Poisson distribution, and the research on a large number of real networks shows that the degree distribution of the actual network is generally followed by the power law form, which is $P(k) \sim k^{-\alpha}$, and the power law distribution curve is slow. Most actual networks can be accurately described, and the distribution of power-free networks, also known as the scaleless network, because the power law distribution function has no scale characteristics, and no scale nature can be defined: assume $f(x)$. For probability distribution functions, if there is any constant a , there is constant b to make $f(x)$ to meet

$$f(ax) = bf(x). \quad (2)$$

It can be said that $f(x)$ meets no scale conditions.

The number of nodes is intended to portray the influence of nodes in the network. Node i weight measurement: the ratio of the total number of connecting nodes j and nodes k , i.e.,

$$C_b(i) = \sum_{j=k} \frac{n_{jk}(i)}{n_{jk}}. \quad (3)$$

Influence can be expressed as the characteristics of an individual or the form of action between individuals, so

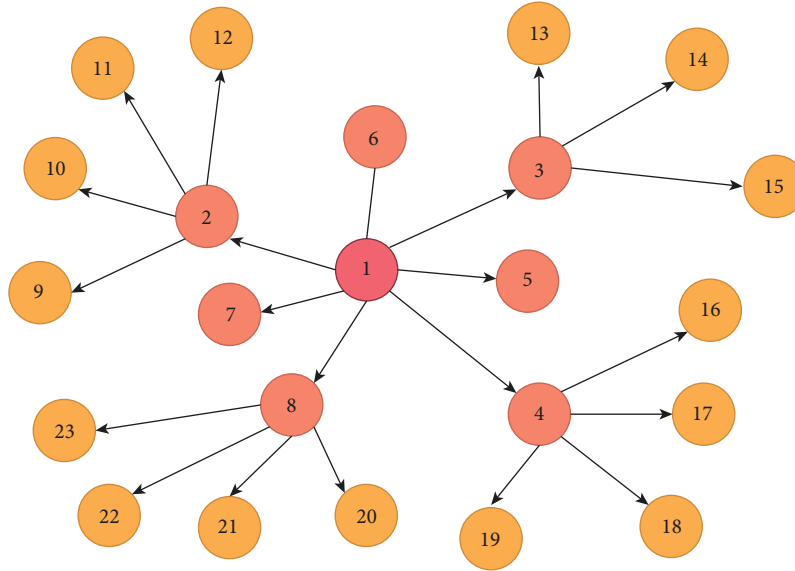


FIGURE 1: Information diffusion cascade.

influence has global and local scope. The influence is expressed according to the behavior characteristics of users on the social network and the statistical indicators of interactive information. The influence of nodes on different topics is also different. They regard the influence as an implicit variable. These documents distinguish the influence in the object and scope of action, which belong to local influence. According to the definition of node dielectric, the maximum number of loads in the information propagation is in an important position of the network, and shortest paths are connected, and the ability to control other node information interactions has reflected the network node pairs. The close level is defined as follows: suppose the total number of nodes of the network is n , and there is a total of the e section between the nodes, and the difference between its edges between the number of equivalent nodes is the density of the network. The density of the nonterminal network is indicated:

$$d = \frac{e}{n(n-1)/2}. \quad (4)$$

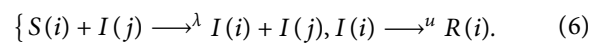
In the direction of the node i and node j , the density of the network is

$$d = \frac{e}{n(n-1)}. \quad (5)$$

3.2. Information Diffusion Cascade. Information diffusion in the Internet mainly depends on the user's forwarding behavior. When a user releases the information, the information is forwarded by its fan, and then forwards the fans of its filaments so that the level of information diffusion is formed. The connection between the user truly reproduces the diffusion path of the information, the node having 0 is the root node, and the node 0 is referred to as the leaves node, as shown in Figure 1 [22].

The epidemiological spread of the real society, the information spread on the Internet, and traffic flow on the road can be regarded as the physical transmission process in the complex network. The spread of viruses in real society has achieved many theoretical research results in recent years. On the one hand, the development of complex network theory has provided research methods; on the other hand, it is highly valued by SARS, AIDS, and other viruses. The virus is propagated on a given network, and the power behavior of the virus can be reproduced, thereby proposing a method of controlling viral propagation. Other physical transmission processes in complex networks can also draw on the viral propagation mathematical model to study the transmission problems of their respective fields [23].

In the SIR model, the node is divided into three states, compared to the SIS model, and there is more R state (immune node). The R node is cured by the i node, or has died, not infected. Its infection mechanism is as follows:



The dynamics equation of this model is shown as follows:

$$\begin{cases} \frac{ds(t)}{dt} = -\lambda i(t)s(t), \\ \frac{di(t)}{dt} = \lambda i(t)s(t) - ui(t), \\ \frac{dr(t)}{dt} = ui(t). \end{cases} \quad (7)$$

As can be seen in this model, there is also an infectious critical value λ_c . When the λ is greater than this value, the node in the I will gradually increase over time, but after a long time, the node in the R state will gradually increase, and the I state node will be reduced to 0, thus ending the infection process.

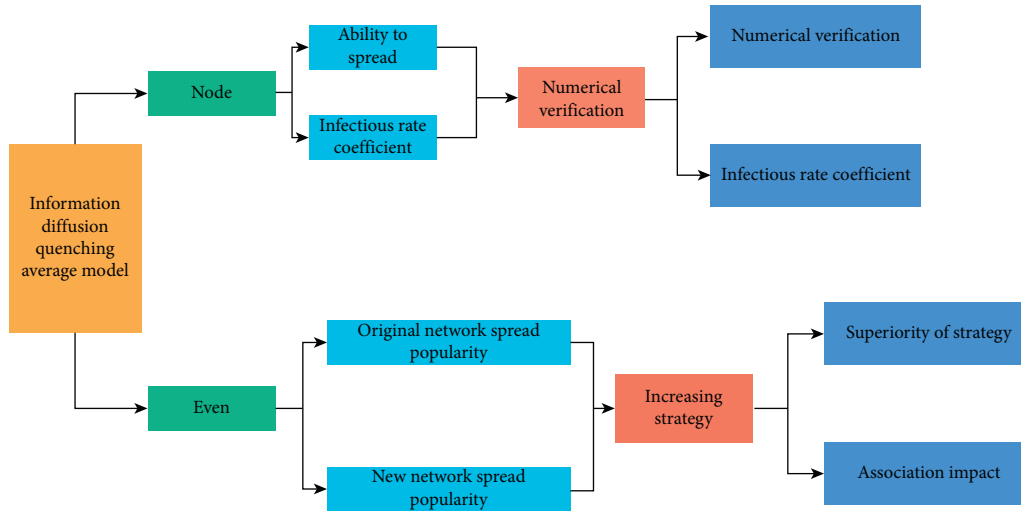


FIGURE 2: Internet information propagation model.

3.3. *Internet Information Communication Network Modeling.* Users in Internet environments can choose to pay attention to objects according to their interests and become their fans, and can also be followed by others, becoming other people’s attention objects [24]. Many articles are based on such concerns and concern relationships to study information. However, the propagation of actual information is not limited, and there is also information propagation between users without paying attention to the relationship. Therefore, the network constructed by information-based propagation can reveal the law of information transmission, as shown in Figure 2.

The information communication network is related to the user’s concern network. If the user released a message, his fans can see it, and he can choose whether to forward it according to his own will; it may exist fans do not forward: If the user sees the content of the self-interested, even if the information publisher is not in the list of your own attention, he can also forward this information [25]. The number of users paying attention to the number of nodes in the network is less than the number of nodes in the information propagation network, and it is not necessarily that the information dissemination is not necessarily along the relationship [26].

4. News Hot Social Event Communication Link Forecast

4.1. *Analysis of Press Hot Point Events in the Internet.* Link prediction is one of the hotspots in complex network fields. The information propagation link prediction refers to the possibility of generating information flow paths between different nodes in the network by information, such as network structures and user behavior. Since link predictions have important actual application value, many field scholars have studied them, such as biotechnology, social network analysis, computer networks, etc. Its main prediction method is to use the Markov chain and machine self-learning, and the prerequisites used in the prediction are

mainly based on node attribute information or network topology.

Based on the prediction of node attributes, it is mainly to utilize similarity between different node properties, and the behavioral characteristics of nodes are used to perform direct propagation link prediction. This prediction result is more accurate, but the attribute of the node needs to be acquired in advance, and the real information of the node’s attributes is difficult to get in the real network. For example, many of the Internet users’ information, for the protection of personal privacy, is confidential. In the personal public information, there is also a large amount of false information. In addition, the user’s behavioral characteristics need to be obtained for a large number of tracking statistics surveys to users. After obtaining accurate information, those materials can be used to predict the links of information, and they also need to be judged. Based on the prediction of node properties, many subjective factors and uncertainties are doped, and it is very difficult to achieve it.

The Internet information propagation complex network is a network. In order to eliminate the impact of the network size, the distribution can be used to describe the distribution of the cumulative distribution function.

$$P_C(k) = \sum_{k_r \leq k} p(k'). \tag{8}$$

When examining the correlation of the Internet information to propagate complex networks, this paper uses nodes of interest and nodes to focus on other nodes to describe the degree and correlation of the Internet information propagation complex network as shown in FIG.

As shown in Figure 3, the same online social network, but the Internet information propagation complex network is substantially negatively correlated, and the generous node tends to be connected to the large node. This shows that there is a psychology in the Internet network. The reasonable explanation of this phenomenon is that the network is growing in the way, and this feature is easy to cause the rich phenomenon to form a “opinion leader.”

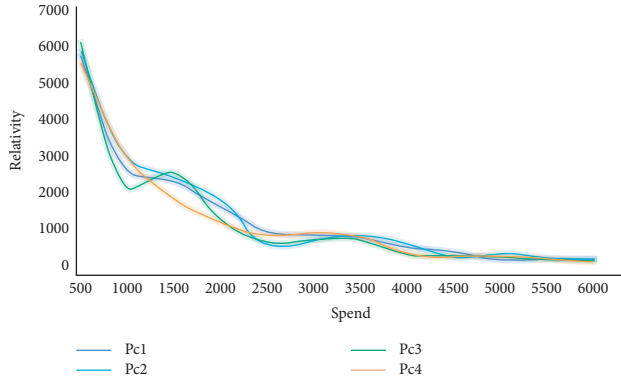


FIGURE 3: Internet information propagation complex network degree and correlation.

4.2. Cluster. Social networks generally have community structures, and there are few intermembers. While different communities are interconnected, this structural feature makes social networks have clustering, which has a great impact on information in the network. As an online social network, the Internet information propagation complex network has clustering. The available cluster coefficients describe the perfect level of network cluster, and the cluster coefficient C_i is defined (8) in the universal network.

$$C_i = \frac{2l_i}{k_i(k_i - 1)}. \quad (9)$$

Among them, l_i is the actual number of edges between adjacent nodes, and k_i is urgently waiting for you. The Internet information propagation complex network is a network, which can believe that there is a relationship as long as there is arc, so it has the same role in an arc and an inner arc. By converting the arc into an edge, multiside between the nodes is merged so that the network is processed into an undirectional network. Early online social network development generally experiences the trend of the S-type curve, that is, the number of users will grow slowly, after a period of cultivation, the explosive growth is started, and as the number of potential users is continuously reduced, it will tend to grow slow, when new and more attractive Internet applications appear, and the old social network began to stagnate, or even recession as shown in Figure 4.

As can be seen from the figure, the Internet is relatively slow in the initial stage, but the network users have increased, so the network density is large. As the number of users increases, the relationship does not grow in a star geometry, so the density begins to decline. After entering the user's high-speed growth period, the users in the network have also begun to become more active, so the network relationship and density begin to increase, but due to the existence of a large number of nonactive users, the network density has gradually decreased. The development process of the Internet has also begun to present S-type. At present, the Internet has already spent the market growth period and user explosion growth period, but it is still in the rising period. It can be expected that the growth rate of the Internet

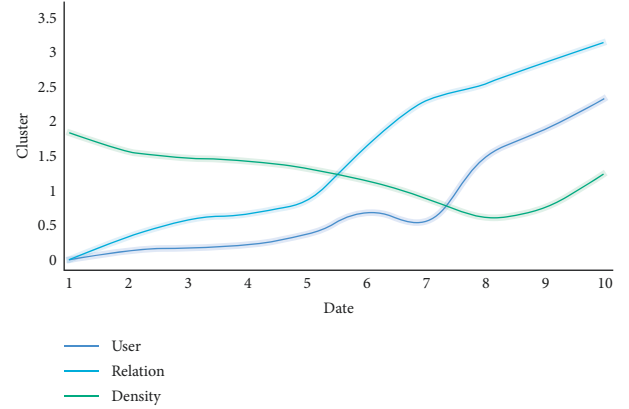


FIGURE 4: Trend of changes in Internet network structure.

will gradually decrease, growth in the next period of time. The process will enter the tail of the S-shaped curve.

4.3. News Hotspot Event Spread Critical Value Mechanism. It is generally considered that only if the effective speed of the propagation exceeds the one-set value, the information may be largely propagated. This value is called the propagation critical value, in the scale network; when the network scale tends to be infinite, the threshold tends to be 0. Any information source may be widely propagated in the network, and the Internet information propagation complex network has significant scaleless, and the related theory of the scale network can be utilized to analyze the critical value of the information propagation.

The degree value of the node is the most intuitive indicator of the importance of the node in the network, but sometimes although a node has a small value, it played a bridge between two groups, and then the node sample is very important. Therefore, it is not always suitable for judging a node. The number of times portrays the intermediary capability of the other two nodes in the node from the perspective of the shortest path, and this paper is based on the information propagation network constructed by the randomly selected user's forwarding behavior and the user-based payment network. For example, the correlation of the node dielectric and degree value is analyzed, as shown in Figure 5.

It can be observed that there are a few times more information propagation networks than the other nodes, and the number of times in the user's attention network is not very prominent. This value is not appropriate. Some network nodes have high values and cannot represent nodes. The research needs to combine the characteristics of the network and synthesize different indicators for evaluation.

5. Internet Information Propagation Simulation Based on Complex Network

5.1. Simulation of Transmission Efficiency Is 1. This paper uses discrete time sequence evolution, in which changes can reflect the speed and breadth of information propagation.

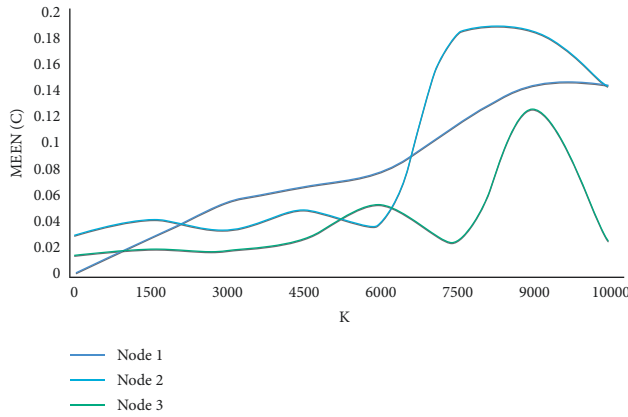


FIGURE 5: Relationship between users' pay attention to network node relationship coefficient and degree value.

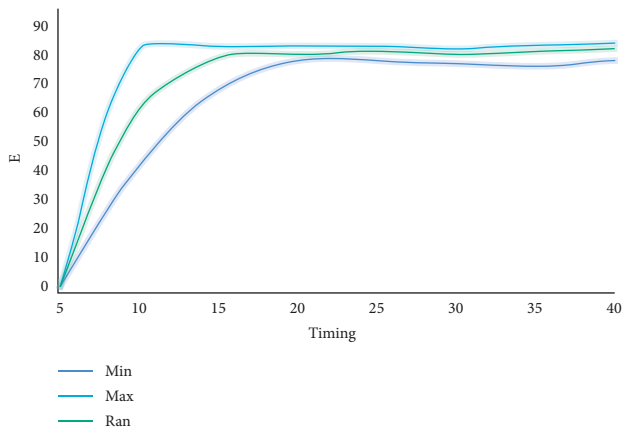


FIGURE 6: Internet information propagation complex network information source simulation.

The simulation conducted in this article is carried out in an Internet network environment. Random networks and rules networks are mainly used to propagate complex networks with Internet information. This paper takes the maximum entry node, the minimum insertion node, degree value, and random node as the information source. By changing different parameters in the model, the diffusion behavior of simulation information in the three types of networks and their parameters is verified.

Assuming the node at the time, the probability of checking the information is 1, that is, after the node accepts information, it immediately propagates all of the attention nodes, which is similar to the virus propagation mode. For Internet information propagation complex network, the simulation results of the maximum degree, minimum, and random three types of information source points are selected as shown in Figure 6.

As can be seen from Figure 6, with the maximum inlet node as the information source node, the speed of information is much higher than the other two, but in the final steady state, the broadness of information propagation does not have much difference, and the information can spread to all nodes. After transmission after 6 and 7 steps, the three

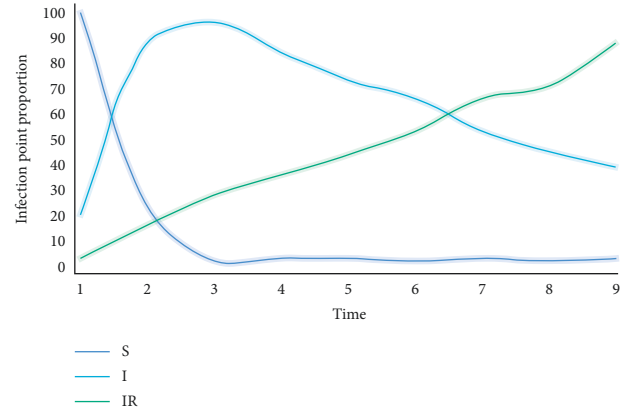


FIGURE 7: Information propagation effect is 85 when the initial relative value is 85.

nodes as the information source, the communication of information in the complex network of Internet information has reached a stable state, which is in line with the “six-degree separation theory.” It can be seen that the speed of information spread is affected by the information source, but the selection of breadth and information sources is not too big.

5.2. Push Information Value on Information Communication Effect Simulation. The scale of information values is not fixed. On the contrary, people will change their original views on information related attributes according to different types of data information received. The diversity of data promotes the emergence of new information analysis tools and changes people’s original attitudes and views on data information processing. Due to the value and influence of information on different groups, the focus is different, so it cannot be measured in the propagation range. This article intends to verify the value of its push information on the influence of user forwarding information, which is virtually college groups of interest and groups that are not interested in this group, and each group selects 300 nodes to perform experimental broadcast. The relative value of 85 and 55 and the evolution effect are shown in Figures 7 and 8.

As shown in Figure 7, if the same-strip information is sent on the Internet, then this information is faster, the speed of propagation is faster, and the propagation range is wider in the population of interest in this information. As shown in Figure 8, if this information is transmitted in the group that is not interested in this information, the propagation of this information is not strictly stopped, but will tend to slowly propagate over time. The experimental simulation results show that the information propagation in the Internet’s information propagation network is more focused on information, which is not the spread of information, than on other social networks. So, we can know that if the user group is very interested in this information, then this information will be accepted and generates a certain influence, and if this information is sent to the crowd that is not interested in this,

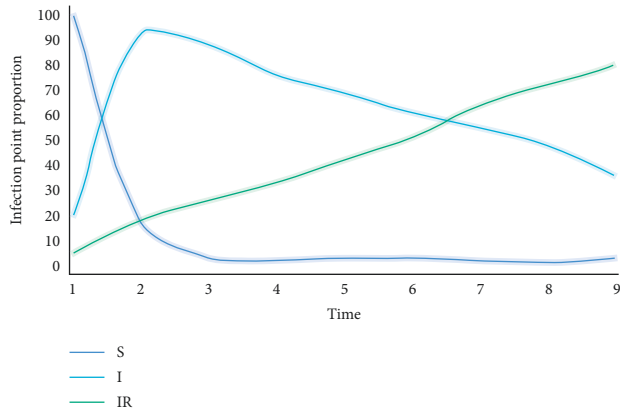


FIGURE 8: Initial relative value is 55 hours of information propagation effect.

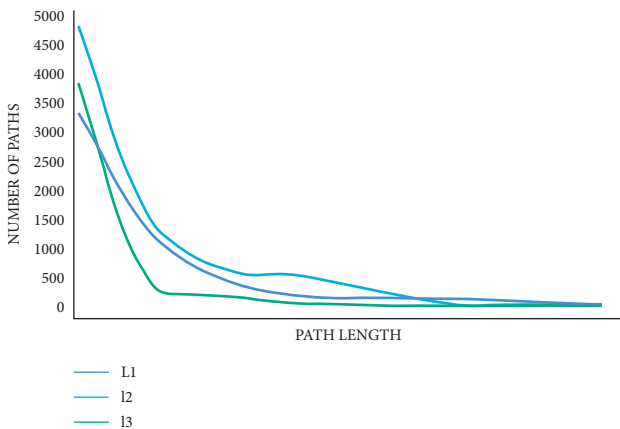


FIGURE 9: Information propagation path length distribution.

then, these users even though received this information, it does not have an influence.

5.3. Internet Information Propagation Path Length Simulation. The validity of the above prediction method is verified as an example in the Internet information forwarding data in Internet data. Since the number of Internet information users is huge and the data update is extremely fast, it can only be used for a certain period of time in a smaller subnet. Combined with the microgroup information propagation network, the propagation of Internet information in the network is analyzed and invalid data are removed to obtain the forwarding process of the Internet information in the network. Each process contains several propagation paths that form a subtree of the network, as shown in Figure 9.

In addition, according to the collected data, not each Internet user's information-sharing behavior can be predicted. This is because there are a considerable number of users in the network, and they only exist as information consumers, with almost no role during the information dissemination. On the other hand, the behavior information of such users is not included in the data, and therefore, it is not possible to predict it. Therefore, it is possible to

determine how the information-sharing behavior of the user can be used to determine how to predict it. The analysis results show that the prediction method is effective, but only a few active users' information-sharing behavior is predictable. In Internet networks, the activity of different users is different. Some users tend to forward information, and they play an important role in the process of information dissemination, and the path of information dissemination contains a lot of preference information about these users, so their information-sharing behaviors are easier to predict; other users only do for the terminal of the information, and it will play a small role in the transmission on the Internet. It hardly contains their preference information in the information propagation path, so it is difficult to predict, but because such users are extremely not active, their sharing behavior is predicted that there is not much significance, so this article only predicts the sharing behavior of this part of the active user, and it still has a practical value.

6. Conclusions

The study analyzed the actual process of information on the Internet and believed that the communication of information mainly depends on the continuous and multilevel forwarding. According to the modeling idea of the typical infectious disease model, two of the nodes in the network information transmission model are in different states, while developing a conversion rule between states, thereby presenting an Internet information propagation model based on a complex network.

The news hotspot event communication network and user payment network have small-world features, and the news hotspot communication network does not show strict scale-free characteristics, and the user's attention network has significant scaleless characteristics; the degree value of the two networks and the corresponding average clustering coefficient have a positive correlation, and the network has a significant hierarchy; the correlation between the nodes of the news hot point event spread network is not as good as the user pays attention to the network. The key role in the information dissemination is the forwarding of the central node to the normal node, and the normal node and the central node play a different role of information communicator and information manufacturers, respectively. By increasing the number of layers of the network dependent on the network, the speed of propagation is found, and the information can be quickly propagated in the network.

Data Availability

The data used to support the findings of this study are available from the corresponding author upon request.

Conflicts of Interest

The author declares that there are no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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