

Study on the Network Effect and Communication Patterns of Non-Heritage Conservation Programs Based on Large-Scale Social Media Data Analysis

Jun Lin and Fei Yuan *

School of Foreign Language, Nanchang Institute of Technology, Nanchang, Jiangxi, 330000, China; faye202505@163.com

Abstract: In this paper, we introduce the topology of large-scale social network to measure the network effect of the non-heritage protection project, and propose a modified SIRI information dissemination model to realize the dissemination of the non-heritage protection project on the basis of short-video social media network. After that, by considering the multidimensional (UGC) communication power of NRM short videos, we construct a UGC-based NRM short video communication power framework, realize the integration of “structure-content-use”, and analyze the communication characteristics of NRM short videos. The results show that the dissemination subjects of NRM protection projects are diversified, the dissemination network is relatively sparse and less complete, and the key nodes in the dissemination network are at the core of the public opinion dissemination network. In the current social network, 15% of the people create 90% of the UGC, and the 67th UGC is the dividing line between high and low retweets. In addition, the dissemination cycle of UGC with high retweets in the network is usually 4~5, and it will go through the three stages of latency-explosion-fading.

Keywords: social media; non-heritage conservation projects; improved SIRI model; information dissemination

1. Introduction

As an important part of Chinese outstanding traditional culture, to realize creative transformation and innovative development, it is necessary to increase the dissemination and popularization of non-legacy and enhance the exchange and mutual understanding of civilizations [1]. The dissemination of non-legacy is typical of the times, both to trace the history, based on reality, but also to predict the future. The dissemination of NRL is not only the simple transmission of its content, but also the living inheritance of a culture [2-4]. With the development of the times, the traditional oral transmission and other methods have been difficult to meet the needs of modern society, the traditional cultural transmission of non-heritage is mainly transmitted and retained in the form of images, and nowadays, relying on the Internet and digital technology, the dissemination of non-heritage in the new era shows new advantages, new features and new breakthroughs, so as to make it glow with new vitality in the context of the new era [5].

In terms of international exchanges and cooperation, the dissemination of non-heritage helps to promote understanding and respect among different civilizations, and promotes the development of cultural diversity in the world [6]. The multifunctional, omni-directional and multi-level communication media under the modernization technology make the non-heritage culture can transcend the time, distance and other limitations, and realize the leapfrog development of cultural communication [7]. Promoting the “going out” of Chinese NRLs will help to show the unique charm of Chinese NRLs, as well as to carry out dialogues and exchanges with the cultural heritage of other countries, and jointly promote the prosperity and development of the world's culture.

In recent years, the rapid rise of social media platforms (WeChat, Jittery, Shutterbug, etc.) has



become one of the main channels for people to obtain information, entertainment and recreation [8]. These platforms have attracted the attention of a large number of users, especially the younger generation, with their convenient use, rich content ecology, and powerful social functions, and high-traffic dissemination characteristics [9-10]. It can be seen that social media can provide an important window for the display, dissemination and promotion of non-heritage culture. On the one hand, social media, relying on the attribute of short and fast, can catch the audience's eyeballs in a short period of time [11]; on the other hand, through the application of creative editing and technical special effects, it can make the content of non-heritage more vivid and interesting, which is easy to be accepted by the public [12]. In addition, social media platforms provide interactive functions such as interactive comments, likes and shares, which help to form a favorable communication atmosphere.

In the era of mobile Internet, everyone is a disseminator and everyone is also a maintainer [13]. People can rely on social media platforms to share and record NRLs, so that NRLs can be brought into common people's homes in a more approachable and grounded way, and more people can be inspired to participate in the protection and inheritance of NRLs [14-15]. At the same time, the social media platform opened a commodity window, linking the sales side and the consumer side, providing a new window for the sale of non-heritage cultural creations with customization and sales. The rational development and utilization of non-heritage has not only realized the transformation from commodity form to cultural and creative economic value, but also injected new vitality into the development of the industry, making the sustainable development of non-heritage possible [16-18]. It can be seen that the social media platform, with its powerful functional attributes, provides a powerful communication carrier and technical support for the dissemination and development of non-legacy, and promotes the high-quality development of non-legacy [19]. Therefore, based on social media data, it is of great significance to analyze the network effect and dissemination mode of NON-heritage in social media, explore the influence mechanism of users' willingness to disseminate NON-heritage, and comprehensively and systematically sort out the difficulties and pain points faced by NON-heritage in the dissemination of social media, so as to better empower the protection and inheritance of China's NON-heritage projects, and to realize the creative transformation and innovative development.

This paper first introduces the topology of large-scale social networks and its evolution process, and then builds a simulated social network based on the topology of BA scale-free network, adding the friend recommendation mechanism and natural growth mechanism, combining with some influencing factors existing in the real network, improving the SIR model, and exploring the influencing mechanism of different factors on the dissemination of information through Matlab simulation experiments. Then, taking the Dragon Boat Festival non-heritage protection project as an example, we simulate the process of information dissemination centering on infectious diseases and information dissemination, and predict its future dissemination trend by accurately analyzing the dissemination process and intensity of the non-heritage protection project. In order to obtain relevant indexes more reasonably and effectively and calculate the communication power of NRL short videos, a UGC-based NRL short video communication power model is constructed from the three dimensions of NRL short videos' content, structure, and communication effect, which simulates and analyzes the process of user creation: UGC acquisition-UGC reading-UGC forwarding, and helps relevant The model simulates and analyzes the process of UGC acquisition, UGC reading and UGC forwarding in user creation, which helps the relevant governmental departments for the protection of non-heritage to formulate positive and effective communication strategies.

2. Topology of large-scale social networks and modeling of information dissemination

2.1. Topology of large-scale social networks

2.1.1. Network Topology Characterization

A network topology [20] is a visual representation of the connectivity of the nodes, which is used to show the functional attributes and dynamic characteristics of the network. Analyzing the physical structure, characteristics and nature of network topology is beneficial in assisting the study of complex networks.

(1) Overall network metrics

Network size refers to the size of the network capacity and depends on the number of nodes in the social network. If the social network is constructed by S nodes, then the size of the network is S . The more nodes there are and the more cross-relationships between nodes, the larger the network size.

① Degree and Degree Distribution

In complex networks, the degree of a node is relatively simple and intuitive, and is usually denoted by

k_r . In an undirected network, the degree of a node is the sum of all neighboring edges. In directed networks, the degree of a node is categorized into: outgoing and incoming degrees. By definition, the more edges are connected to a node, then the more important the node is in the network. The average degree of a node in a network is denoted by $\langle k \rangle$. In a given network, there is an adjacency matrix

$$A = (a_{ij})_{N \times N} :$$

$$k_r = \sum_{j=1}^N a_{ij} = \sum_{j=1}^N a_{ij} \quad (1)$$

$$\langle k \rangle = \frac{1}{N} \sum_{j=1}^N a_{ij} = \frac{1}{N} \sum_{j=1}^N a_{ij} \quad (2)$$

② average path length

Shortest path, the shortest line connecting nodes m and n , the distance d_{mn} between two nodes can be expressed as the number of edge nodes m to nodes n on the shortest path. If the two nodes are identical nodes or when they cannot be connected to each other, then $d_{mn} = 0$. Thus, the average path length is equal to the average value of the path between two nodes in the network, which can be denoted by L :

$$L = \frac{1}{\frac{1}{2} N(N-1)} \sum_{m \geq n} d_{mn} \quad (3)$$

The total number of nodes of the network is denoted by N .

③ Clustering coefficient

Clustering coefficient is used to weigh the magnitude of correlation and denseness between neighboring nodes of a node in the network. In the following equation, k_m denotes the number of edges of node m and also the number of neighboring nodes k_m of node m , $k_m(k_m - 1)/2$ denotes the number of edges that exist between nodes of k_m , and E_m denotes the number of actual edges between neighboring nodes, thus, node m has a clustering coefficient of C_m :

$$C_m = \frac{E_m}{(k_m(k_m - 1))/2} = \frac{2E_m}{k_m(k_m - 1)} \quad (4)$$

C denotes the average of the sum of the clustering coefficients of all nodes, which also represents the clustering coefficients of the entire network, i.e:

$$C = \frac{1}{N} \sum_{m=1}^N C_m \quad (5)$$

The total number of nodes in the network is denoted by N . If the clustering coefficient is 0, it indicates that the nodes in the network are not connected and independent of each other; if the clustering coefficient is 1, then all the nodes in the network are related to each other.

(2) Measurement of network node centrality

One of the important research contents of social network is “centrality analysis”. The centrality of nodes includes point centrality, proximity centrality and intermediate centrality.

① Point centrality

If there are N nodes in a social network, and the edges connected are all undirected, the point centrality of a node m is the total number of associations between m and the remaining nodes, which reflects the degree of associations between the nodes:

$$C_D(N_m) = \sum_{n=1}^g X_{mn} (m \neq n) \quad (6)$$

② Proximity centrality

The proximity centrality of a node is the sum of the shortest distances between that node and the rest of the nodes in the social network, expressed as an indicator of proximity. Where d_{mn} is the shortest distance between node m and node n :

$$C_{AP}^{-1} = \sum_{n=1}^j d_{mn} \quad (7)$$

③ Intermediate degree of centrality

If there are nodes j and nodes k in the network, and the number of all paths in the two nodes is denoted by G_{jk} , assuming that some of the paths in the connection paths between nodes j and nodes k need to pass through node i , then $G_{jk}(i)$ denotes the number of paths between the two nodes that are connected through i , and therefore the social The formula for the intermediate centrality of node i in a network is as follows:

$$C_{AB} = \sum_j^n \sum_k^n b_{jk}(i), j \neq k \neq i, \text{ and } j < k \quad (8)$$

2.1.2. Network model evolution

(1) Randomized Networks

Randomized networks are constructed in the form of fixed connected edges and fixed connected edge probabilities in $G(N, m)$ and $G(N, p)$, respectively. In $G(N, m)$, two unconnected nodes are arbitrarily taken from N nodes and an edge is added at the same time, and after iterating all the nodes m times, it will contain a network of N nodes and m edges. In $G(N, p)$, there are N nodes, and the connected edges are not given, so two unconnected nodes are arbitrarily drawn from the N nodes with probability p .

(2) Small-world network

A small-world network model between regular and random, which has a shorter average path length and higher clustering coefficients, and is closer to a real network.

Constructing a small-world network model is divided into two steps:

① Modeling regular networks. First construct a nearest neighbor network with N nodes, in which each node is connected by $k/2$ neighboring nodes, and k is an even number.

② Randomized connections. In the network constructed in the first stage, any two nodes are connected randomly based on the probability p , i.e., a node is found randomly in the given network and other nodes are found randomly in that network and connections are established at other nodes.

When $p = 0$, it belongs to a completely regular network; when $p = 1$, it belongs to a completely random network; when p takes a value between 0 and 1, a transition is made from a regular network to a random network, and the transition part is a small-world network.

The clustering coefficient $C(p)$ of the small-world network is shown in the following equation:

$$C(p) = \frac{3(K-2)}{4(K-1)} \quad (9)$$

When $p = 0$, it belongs to the most neighboring coupled network model, obtaining $C(0) \approx 3/4$, $L(0) \approx N/2K$, at this time, the network structure has high clustering as well as longer average path characteristics; when $0 < p \ll 1$, it obtains $C(p) \approx C(0)$, $L(p) \ll L(0)$, when the network structure has small-world characteristics, the clustering coefficients change little, and the length of the average path becomes shorter.

(3) Scale-free networks

Scale-free network models explore complex networks closer to reality. Scale-free network modeling is established by:

① Network growth: there are point sets m_0 nodes in the interconnected network, and new nodes are added in order to construct connecting edges with m nodes in the network.

② Priority connectivity: when the newly added nodes and the remaining nodes to connect between

the nodes, will be preferred to combine the higher degree of the node, and the newly added nodes and the existing nodes i connection chance and node i degree k_i of the relationship between the nodes is:

$$\prod_i k_i = \frac{k_i}{\sum_j k_j} \quad (10)$$

The $\sum_j k_j$ represents the total node degree of the network, which after t time contains $N = t + m_0$ nodes as well as $M + mt$ edges, and the number of connections the nodes have in the initial network when M style $t = 0$.

2.2. SIRI-based dynamic network information dissemination models

2.2.1. Simulation of Social Network Assumptions

In the process of constructing the social network topology model, it is necessary to consider the processes of node entry and exit, and the addition and cancellation of edges between nodes and nodes, and this paper combines the analysis of social network users' attention behaviors to put forward the assumptions of this simulation network model:

(1) Node entry: in the network there are constantly new users registering into the social network, which is manifested as the addition of new nodes. In the process of social network construction, it is assumed that new nodes are added at every point in time, and the more time iterations, the more the number of nodes, indicating that new users register into the social network at every point in time.

(2) Node Logout: In social networks there are also many users who choose to logout and no longer log in. In the simulation network indicates a decrease in the number of nodes in the network, and its accounted for in the social network construction model does not take into account the exit of nodes.

(3) The increase of the edge: the construction of interrelationships between users is manifested in two forms, one form for the newly joined nodes and the nodes of the original network to increase the edge of the interconnection, and the other form is the point in the network does not become when due to the concern to increase the edge between users.

(4) The decrease of the edge: cancel the attention between the users, the edge between the nodes decreases, the probability of canceling the attention between the users is small, in the construction of the social network assumed in this paper to construct a directed network only considering the nodes to enter and the edge increase.

2.2.2. Simulation of social network model evolution algorithm

Based on the previous assumptions about the model and the mechanism of proposing an improved network model, this paper derives the following algorithm for the network evolution model based on BA scale-free networks:

Input: initial nodes of the network n_0 , initial edges m_0 , growing nodes i , network size N .

Output: a topological model of the eligible social network.

Step 1: Initialization of the network: let the initial state of the network have n_0 nodes and m_0 directed edges, so that the points between the network are connected to each other to form a network with head and tail, and set the number of the network to be N .

Step 2: Growth principle: add a node i at each time point to the original network. When node i is added to the network, add m_1 edges pointing to node i and m_2 edges pointing to other nodes from node i . Assume that the probability that a node i is connected to the original node j when adding m_1 edges pointing to the incoming degree of node i is:

$$\prod(k_j) = \frac{k_j}{\sum_{t \in V} k_t} \quad (11)$$

where k_j denotes the out-degree of node j , and the sum of out-degrees of all original nodes is denoted by $\sum_{t \in V} k_t$.

The probability that a node i is connected to an original node j when adding an edge that adds m_2 that points from node i to the out-degree of other nodes in the original network is:

$$\prod(k_j) = \frac{k_j'}{\sum_{i \in V} k_i'} \quad (12)$$

where k_j' denotes the out-degree of node j , and the sum of the out-degrees of all the original nodes is denoted by $\sum_{i \in V} k_i'$.

Step 3: Priority linking principle: the probability of occupying an edge from m edges at each time is proportional to the node's degree k_i , then it is obvious that the earlier the node joins the easier it is to get more link counts. Starting from time 0, the degree of nodes in the system is increasing k_i at each time step.

Step 4: Natural Growth Principle: In each time iteration, a node is randomly selected in the network to be connected to other $P_0 \cdot N$ nodes in one direction.

Step 5: Buddy Recommendation Principle: In each time iteration, randomly select a node j with a proportion of P_1 , for the selected node j , and then randomly select two nodes adjacent to this node, and add bidirectional edges between these two neighboring nodes to indicate that the two users pay attention to each other. Where P_0 and P_1 are the speed of edge addition.

2.3. Improved SIRI social network information dissemination model

2.3.1. SIRI model

The SIR model under rule-based networks cannot faithfully reflect the information propagation law in social networks. Based on this SIR model, the SIRI model is proposed by considering that the final immune state R will not become an absorbing state in the process of information propagation, and the nodes in the R state will be transformed into the propagation state I again with a certain probability [21].

In the SIRI model, all the individuals in the social network system are also divided into three states susceptible state S, infected state I and immune state R. Comparing with the SIR model, there is no increase in the types of nodes. The transition from state R to state I is added to the propagation model, in the system network, the probability that the susceptible state S is infected to state I is λ , the probability that the infected state I is transformed to state R after a certain period of time is μ , and the probability that the node in the immune state becomes the propagated state I again due to its own reasons or due to external reasons is α . The corresponding S-state, I-state and R-state individual densities at the moment of system t are $s(t)$, $i(t)$ and $r(t)$, respectively. The corresponding set of equations for the dynamics of the SIRI infection is:

$$\begin{cases} \frac{ds(t)}{dt} = -\lambda s(t) \\ \frac{di(t)}{dt} = \lambda s(t) - \mu i(t) + \alpha r(t) \\ \frac{dr(t)}{dt} = \mu i(t) - \alpha r(t) \end{cases} \quad (13)$$

2.3.2. Improved SIRI propagation models

According to the characteristics of information dissemination in social networks, for a few differences with the infectious disease model, information dissemination nodes in social networks can be divided into three states:

- (1) State S---- information unknown, the user has not received the information.
- (2) State I---- information propagator, the user receives the information and spreads it.
- (3) State R---- information ignorer, the user receives the information and ignores it without any

dissemination behavior. The improved information dissemination model in the SIRI social network is shown in Figure 1.

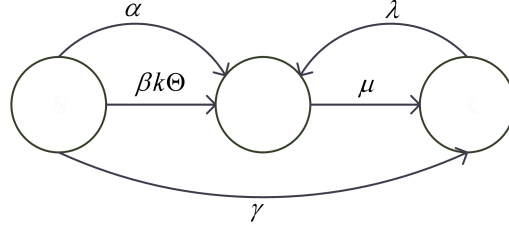


Figure 1. An enhanced information dissemination model for SIRI social networks.

Therefore construct the equation for the dynamics of information dissemination in social networks:

$$\begin{cases} \frac{ds_k(t)}{dt} = -\beta K\Theta(t)s_k(t) - \alpha s_k(t) - \gamma s_k(t) \\ \frac{di_k(t)}{dt} = \beta K\Theta(t)s_k(t) + \alpha s_k(t) + \lambda r_k(t) - \mu i_k(t) \\ \frac{dr_k(t)}{dt} = \gamma s_k(t) - \lambda r_k(t) + \mu i_k(t) \end{cases} \quad (14)$$

Where: k denotes the incidence of infectious nodes in the network, $P(k)$ denotes the degree distribution function in the simulated social network, and $\langle k \rangle$ denotes the average degree of the nodes on this social network. $s_k(t)$ represents the density of information unknown individuals with an dimension of k at time t , $i_k(t)$ represents the density of information disseminators with an dimension of k at time t , $r_k(t)$ represents the density of information ignorators with an dimension of k at time t , α represents the spontaneous dissemination rate influenced by the external environment, and β represents the dissemination probability influenced by the information dissemination nodes in the social network. γ represents the probability that an information unknown person, after coming into contact with the information, does not react to it and turns into an information ignorator. μ represents the probability that an information disseminator stops spreading information after a certain period of time and thus ignores it. λ represents the probability that an information ignorator, influenced by the information on other social platforms, turns into an information disseminator.

2.4. Simulation of the results of the improved SIRI social network information dissemination

The article uses matlab to simulate the constructed model, in the simulation process, all the differential equations are converted into programming language, run matlab to derive the simulation graphs, and then based on the analysis of the model and the method of setting the parameters of the node maturity in the domain. Assuming that the total number of nodes is 1000, each node represents a person, where one node represents the initial propagation node, $S(t) = 999$, $E(t) = 0$, $I(t) = 1$, $R(t) = 0$. The coefficient of the easy propagator comment in the experiment, the density of the information propagation nodes, and the density of the information ignorers are denoted by $S(t)$, $I(t)$, and $R(t)$, respectively.

2.4.1. Coefficient of easy-to-propagate comments

The easy propagator comment coefficient refers to the chance that the propagator node user will be converted to the comment node user under the influence of the propagator. Assume the parameter values in the simulation test to observe the influence of the easy propagator comment coefficient under different values on the mechanism of social media information dissemination, and the evaluation coefficient α is taken as 0.2 in the test process while keeping other parameters unchanged.

The results of the simulation experiment of the easy propagator comment coefficient are shown in Fig. 2: when the easy propagator comment coefficient increases, along with the change of time, the number of

easy propagator nodes decreases at a faster rate, and finally tends to zero. The number of propagator nodes does not change significantly. The number of immunizer nodes shows a decreasing trend after reaching the peak. Based on the above simulation study, it can be seen that in the process of social media information dissemination, the higher the coefficient of easy spreader comment, the faster the speed of easy spreader node transformation, i.e., the information can be spread and diffused quickly.

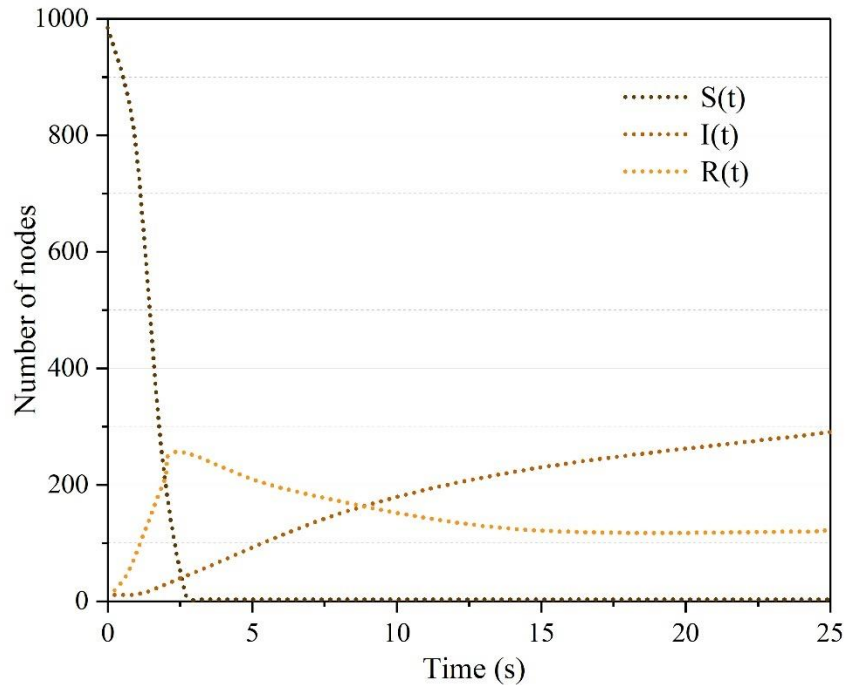


Figure 2. Simulation results of the contagion coefficient.

2.4.2. Dissemination conversion rate

The value of propagation conversion rate $c_1=c_2$ is changed to 0.3. The simulation results of propagation conversion rate are shown in Fig. 3. When the propagation conversion rate is elevated, along with the advancement of time, the number of easy propagator nodes $S(t)$ decreases at a faster rate and finally tends to zero in a shorter time. The propagator node $I(t)$ propagation rate increases at a substantially higher rate of increase in number as the propagation conversion rate is elevated, and the fixed value to which it eventually converges is also substantially elevated. The immunizer node $R(t)$ likewise has a large proportionally higher rate of increase in number as the propagation conversion rate increases, and the number of nodes peaks from the propagation rate $c_1=c_2=0.025$ at about $t=2.15$ s. Meanwhile, the immune node's final tendency to a fixed value is also accompanied by a slow decrease in the elevation of the propagation rate. It can be seen that changing the propagation conversion rate has a huge impact on the state change of easy propagator nodes, propagator nodes and immune nodes. As the propagation conversion rate increases, the time for each node to converge to the stabilization value is shortened, and the stabilization value changes for all nodes except the easy propagator node. It also shows that in social media information dissemination, the closer the relationship between users, the faster the rate of information dissemination.

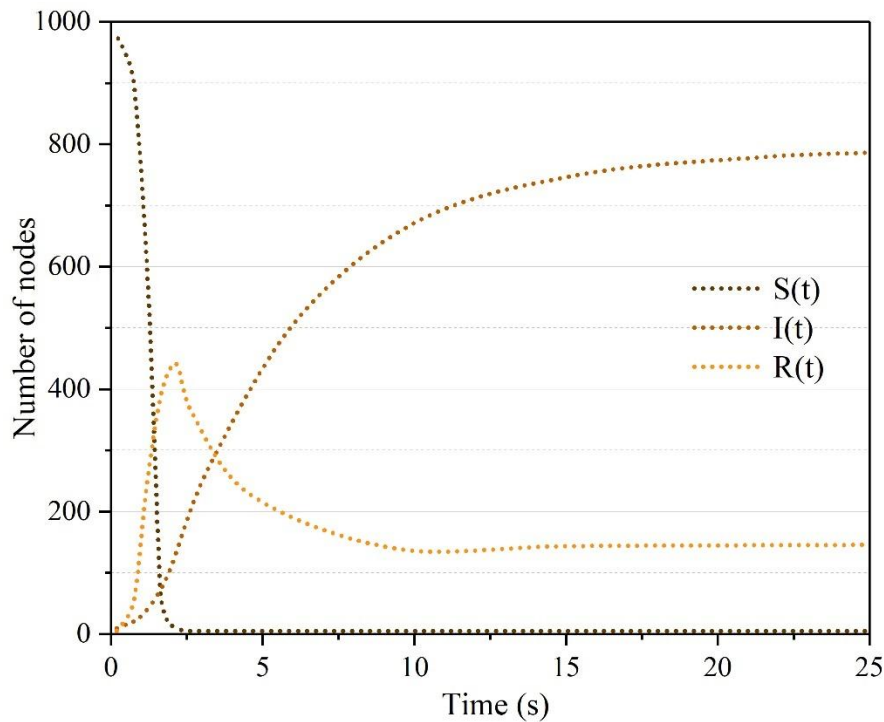


Figure 3. Conversion rate simulation results.

2.4.3. Immunization factor

The immunity coefficient of a social media user is the probability that the user will lose interest in the message when he receives it, and the larger value of the immunizer node indicates that more users quit the propagation. In order to eliminate the influence of other parameters on the results, it is also ensured that the initial value of each parameter remains unchanged, so that the immunity coefficient z is 0.2. The simulation results of the immunity coefficient are shown in Fig. 4: It can be seen that when the immunity coefficient is increased, the easy to change with time propagator nodes remain almost unchanged. The propagator node tends to stabilize at a faster rate, and the value after stabilization shows a gradually decreasing trend. The peak value as well as the rate of change of the immunizer node remains almost unchanged, and the stable value is gradually increasing after the change relationship between the nodes is stabilized. It can be seen that the increase of the immunity coefficient c is closely related to the propagator nodes and the immunizer nodes, in which the more obvious relationship is that the number of propagator nodes is inversely related to the immunity coefficient. In daily life, the immunity coefficient plays a key role in the information dissemination of mobile social networks based on strong relationships, and the control of information dissemination can be carried out by changing the immunity coefficient.

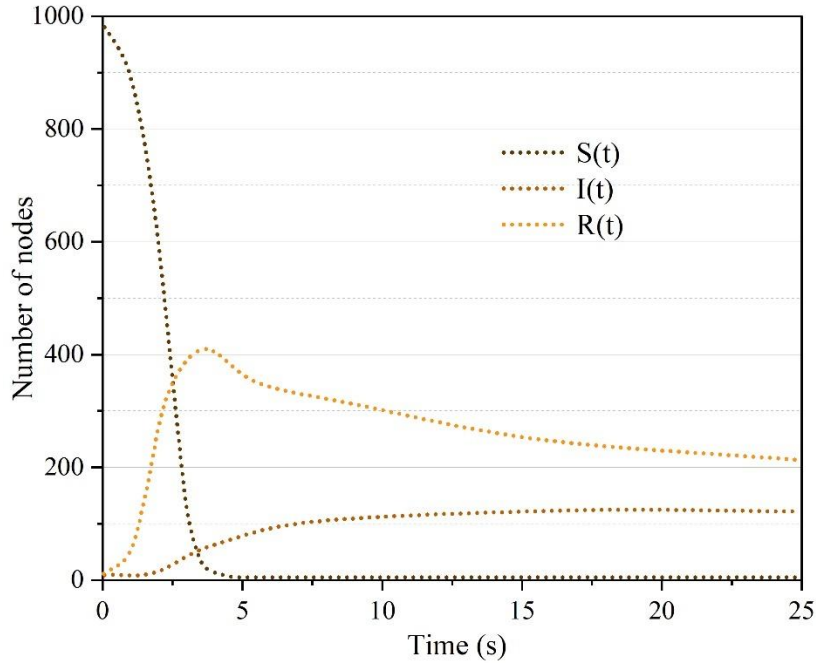


Figure 4. Simulation results of the immune coefficient.

3. Construction of a model for network communication of non-heritage conservation projects and analysis of application effects

3.1. Network effects of social media communication for NRM projects

In this section, this paper takes the Dragon Boat Festival, a non-heritage preservation project in China, as an example to analyze the effect of its communication in large-scale social media.

3.1.1. Centrality analysis

(1) Point degree centrality analysis

The results of the point degree centrality are shown in Table 1, the highest point degree centrality value of the user node Cloud Dragon Boat Race Live in the Dragon Boat Festival network, indicating that the emotional impact of this node is the greatest, and the node may be a frequent exchange of information, which plays a role in the core of the influence of emotional dissemination. Followed by dumplings DIY short video tutorials, Dragon Boat Festival digital gift boxes/creative literature, Dragon Boat Festival Flying Flower Order, VR/AR experience of Dragon Boat Festival folklore, and the national style game Dragon Boat Festival, from the results of the measurement of the centrality degree of the point degree, it can be assumed that these nodes are the communication guides of the Dragon Boat Festival, and have a close and complex connection with other nodes, and have a great impact on the information dissemination and exchange of non-heritage protection projects.

Table 1. The result of the degree centrality.

Order number	Panel point	Point Degree Centrality
1	Dragon Boat Race LIVE	5.7366
2	Zongzi DIY short video tutorial	5.4104
3	Digital gift box for Dragon Boat Festival / cultural and creative products	5.0257
4	Dragon Boat Festival Flower Order	4.4622
5	VR/AR experience of Dragon Boat Festival customs	3.4781

6	Dragon Boat Festival Games	3.0903
7	Live show by intangible cultural heritage inheritors	3.0692
8	Social Media Topic Challenge	3.0504
9	Dragon Boat Race	2.0925
10	Dragon Boat Festival	1.9538
...

(2) Analysis of mediator centrality degree

The results of intermediary centrality degree are shown in Table 2, the highest is the witty Xuexue, followed by nodes such as People's Daily, dumpling DIY short video tutorials, and Dragon Boat Festival Digital Gift Boxes/Cultural Creations, etc. It can be seen that the above mentioned users are an important bridge to disseminate the relevant information in the corresponding time, and they play a more prominent role in controlling the control ability of the other nodes and interoperability of the information resources with the specific dissemination rights, and they can control the public opinion in the network dissemination. In addition, there are more than half of the users in the network with intermediary centrality value lower than 20, their influence is small, their access to resources is relatively limited, they play a less important role in emotion dissemination, and they are in the fringe of the network, with a lower ability to control the interaction of other nodes.

Table 2. Results of the intermediary centrality.

Order number	Panel point	Intermediary Centrality
1	Smart Learning	208
2	People's Daily	159
3	Digital gift box for Dragon Boat Festival / cultural and creative products	155
4	Dragon Boat Festival Flower Order	128
5	Guide to 100 Faces and 1,000 Forms	106
6	Kangaroo Didi	19
7	CCTV News	15
8	Dragon Boat Race LIVE	8
9	VR/AR experience of Dragon Boat Festival customs	5
10	Dragon Boat Festival Games	2
...

(3) Analysis of proximity centrality degree

The results of the proximity to the center degree are shown in Table 3. The low value of the intermediary center degree of Witty Xuexue, People's Daily, Dragon Boat Festival Digital Gift Box/Cultural Creation, and Rice Dumplings DIY Short Video Tutorials indicates that these points are closer to the center of the network, have an advantage in emotional influence, have a high power prestige in the process of spreading the emotional information, have close ties with other members of the network, and are also less susceptible to the control of others when spreading the information and not dependent on others. The result of proximity to the center further proves that the above users are the opinion leaders in the emotional dissemination of online public opinion in this non-heritage protection project.

Table 3. Results close to centrality.

Order number	Panel point	Close to the center
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1	Smart Learning	2789
2	People's Daily	2791
3	Digital gift box for Dragon Boat Festival / cultural and creative products	2794
4	Zongzi DIY short video tutorial	2800
5	Guide to 100 Faces and 1,000 Forms	2801
6	CCTV News	2798
7	Light the fire	2805
8	News to Know the World_80964	2811
9	Kangaroo Didi	2815
10	VR/AR experience of Dragon Boat Festival customs	2819
...

3.1.2. Structural hole analysis

The results of the structural hole measurements of the NPO-Duanwu Festival are shown in Table 4. It can be found that in the Dragon Boat Festival network, the effective scale value of the Smart Xue Xue user node is 5.0165, and the maximum limit value is 0.2229. Next come the nodes such as Kangaroo Didi, Dragon Boat Festival Digital Gift Box/Cultural and Creative, People's Daily, and CCTV News, etc. The maximum limit value of the effective scale value is small, which means that these nodes are not easily controlled by others. Nodes with lower limit values are subject to fewer constraints. They act as "Bridges" among multiple nodes, making it easier for them to obtain information resources and occupy more structural holes, which strongly proves that they are core nodes.

Table 4. Dongguan festival structural hole measurement results.

User node	EffSize (Effective Size)	Constrain (Limit)
People's Daily	2.9822	0.3908
CCTV News	1.9975	0.4924
Global Times	0.9904	0.991
Digital gift box for Dragon Boat Festival / cultural and creative products	4.9971	0.1890
Dragon Boat Festival Games	0.9992	1.0114
Smart Learning	5.0165	0.2229
Kangaroo Didi	2.9981	0.3505
Guide to 100 Faces and 1,000 Forms	3.0158	1.0037
DriftersC	0.0092	0.0134
Live show by intangible cultural heritage inheritors	1.0031	1.0112
...

3.1.3. Density and distance analysis

(1) Network density analysis

In the result of network density, the network density of Dragon Boat Festival is 0.0182, which indicates that the network wholeness of Dragon Boat Festival is relatively low, the overall connection of the network is relatively loose, and the nodes are less connected to each other, communicating with each other less, and the relationship is not close enough.

(2) Distance analysis

As shown in Table 5, the average network distance between nodes is 3.1308, indicating that in the network public opinion dissemination of Dragon Boat Festival, any three nodes can establish a relationship through three nodes on average. The value of the connection coefficient based on “distance” is 0.0351, which is relatively small, indicating that the nodes in the network public opinion dissemination of the Dragon Boat Festival are not too closely connected with each other, and that the overall communication among the members is low, and the overall cohesion is also weak.

Table 5. Dragon Boat Festival network distance measurement results.

For each pair of nodes, the algorithm finds the #of edges in the shortest path between them.	
Test specification	Numeric value
Average distance (among reachable pairs)	3.1308
Distance-based cohesion (compactness)	0.0351
Distance-weighted fragmentation (breadth”)	0.9567

3.1.4. Core-edge analysis

In UCINET software, the core-edge analysis is performed for the Dragon Boat Festival. The results of the core-edge density matrix of the Dragon Boat Festival are shown in Table 6. It can be concluded that the density value between core nodes in the network population is 0.2288, the density value between core nodes and edge nodes is 0.0624, and the density value between edge nodes is 0.0094. The density between core nodes is relatively high; there is a tendency to establish a relationship between edge nodes and core nodes, but the interaction relationship is not close; the interaction relationship between edge nodes is not close and the tendency to interact is also low.

Table 6. Core-periphery density matrix results for the Dragon Boat Festival.

	Core	Border
Core	0.2288	0.0624
Border	0.0624	0.0094

3.2. UGC-based non-heritage short video communication power model construction

Through the analysis of the various elements of intangible cultural heritage short video dissemination based on the Dragon Boat Festival in the previous text, it is found that the dissemination power model that only considers the disseminator, audience or dissemination medium is insufficient to comprehensively reveal the dissemination effect of intangible cultural heritage short videos. Therefore, this study comprehensively considers the dissemination power of intangible cultural heritage short videos from the aspects of content characteristics, structural characteristics and dissemination effect characteristics. By constructing a multi-dimensional (UGC) framework for the dissemination power of intangible cultural heritage short videos, the aim is to achieve the integration of "structure - content - usage", and provide knowledge boundaries and volumes for the subsequent design and selection of the dissemination feature quantities of intangible cultural heritage short videos. The multi-dimensional analysis framework for the dissemination power of intangible cultural heritage short videos is shown in Figure 5.

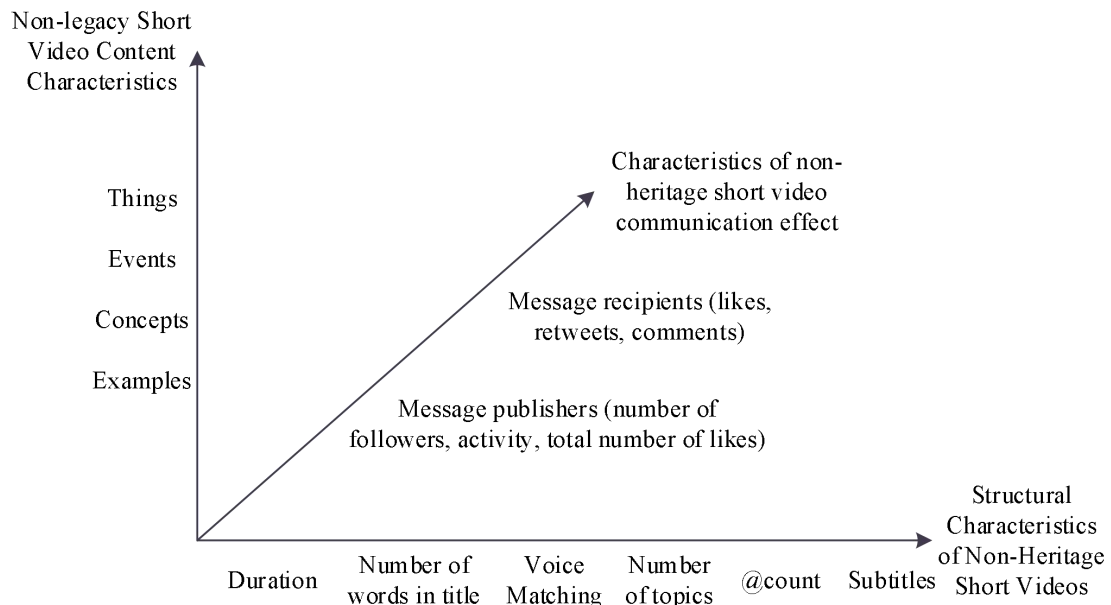


Figure 5. UGC-based short video dissemination model for intangible cultural heritage.

3.2.1. Content Characteristics of Non-Heritage Short Videos

This study will analyze the types of non-legacy short videos and their video title introductions, and go deeper into the UGC non-legacy short video content feature dimension to construct non-legacy short video communication power.

In the current study, based on the abstraction degree of knowledge, the multi-granularity representation of knowledge resources can be divided into four levels of granularity: instance knowledge, concept knowledge, event knowledge and matter knowledge. In the selection of the content characteristics of non-legacy short videos, the content characteristics of non-legacy short videos are divided into non-legacy instances, non-legacy concepts, non-legacy events, and non-legacy matters, drawing on the four levels of granularity of the content characteristics of the non-legacy short videos. Instance refers to all the concrete things that exist in the world, and each instance has a specific type, which is described by an abstract concept. And the concept is the abstract revelation and description of the essential connotation of the concrete instance object.

In this study, the non-legacy instances are defined as the specific non-legacy project instance objects appearing in the title text introduction of the non-legacy short video, which is the most fine-grained description of the non-legacy cultural content, and the non-legacy concepts are defined as the abstract and general revelation and description of the connotations of the non-legacy specific instance objects.

In this study, the non-legacy event refers to a specific event in a non-legacy program. Event is a general term for the development and change of things, reason, used to connect the object of practice with the purpose to achieve the goal. In the communication of non-heritage short videos, non-heritage matter of fact is a distinction for the type of non-heritage short videos, and the content contained in different non-heritage short videos as well as the purposefulness of the communication is different.

3.2.2. Structural Characteristics of Non-Heritage Short Videos

The structural features of non-legacy short videos are also an important dimension that affects communication power. The structural characteristics of non-legacy short videos can make the information receivers have an impression and understanding of non-legacy short videos in a short time. In the structural description of short videos of non-heritage, the length of the video and the number of words in the title can reflect the completeness of the video and the richness of the information, the longer the length of the video and the more detailed the description of the title text, the richer the content information it contains. As the public has not yet had an in-depth and detailed understanding of the non-heritage culture, generally speaking, the richer and more detailed non-heritage short videos are more likely to attract the attention of users and be understood by users, thus achieving better communication effects.

In addition, the degree of matching between the sound of the video and the actual content of the video, and whether the video has subtitles or not will have an impact on the information received by the users,

thus further affecting their interactive communication behavior. Thus, the communication power of NRM short videos will be affected by structural factors such as the length, the number of words in the title, the matching degree of background music and subtitles.

3.2.3. Characteristics of non-heritage short video communication effect

Communication effect is the external characterization of the strength of communication power. The depth and breadth of the dissemination of non-heritage short videos are affected by the short video publishers and receivers, on the one hand, the strength of the dissemination subject is the basis for analyzing the dissemination power. For the dissemination of non-heritage short videos, the attributes of its dissemination subject will have an impact on the dissemination power. The number of fans can characterize the size of the user's influence range, and different numbers of fans make different dissemination subjects have different degrees of attention and initial dissemination range. At the same time, there are certain differences in the production and operation ability of different short video accounts. The total number of likes represents the degree of user recognition and love for the content produced by the user, and the higher the total number of likes, the stronger the ability to produce and create high-quality short videos, and the more easily the content released is accepted by the users, and the stronger the dissemination ability is.

On the other hand, in the communication of non-heritage short videos, its communication effect is also closely related to the interactive data of the short video in a certain period of time, such as the number of likes, retweets and comments. The interactive behavior generated by users after receiving the information is one of the visual manifestations of the communication effect of non-heritage short videos.

3.3. *Analysis of Information Dissemination Effect of Non-Heritage Protection Project Based on UGC*

3.3.1. UGC propagation simulation

In this paper, we take the user attributes of creating UGC as the main reason affecting the UGC attributes, and the basic attributes include: ID, creating user ID, interest tag, creation time, reading user list, forwarding user list. After determining the UGC attributes and event attributes, according to the section information dissemination conceptual model, we set the UGC from generation to dissemination will go through a process such as UGC creation - UGC selection - UGC reading - UGC forwarding, and there is a threshold limitation for each process. In this paper, we set the information dissemination model to simulate the social network behavior of a single individual, and through the statistics of a single individual's behavior accumulated to the dissemination law of the whole social network users. The UGC propagation process of a single node is shown in Figure 6, and the overall propagation process of the network is simulated in three steps:

- (1) Count the current online users.
- (2) Select a node of current online users to simulate the process of creating UGC, screening UGC, reading UGC and forwarding UGC.
- (3) Simulate the UGC dissemination process of all online users.

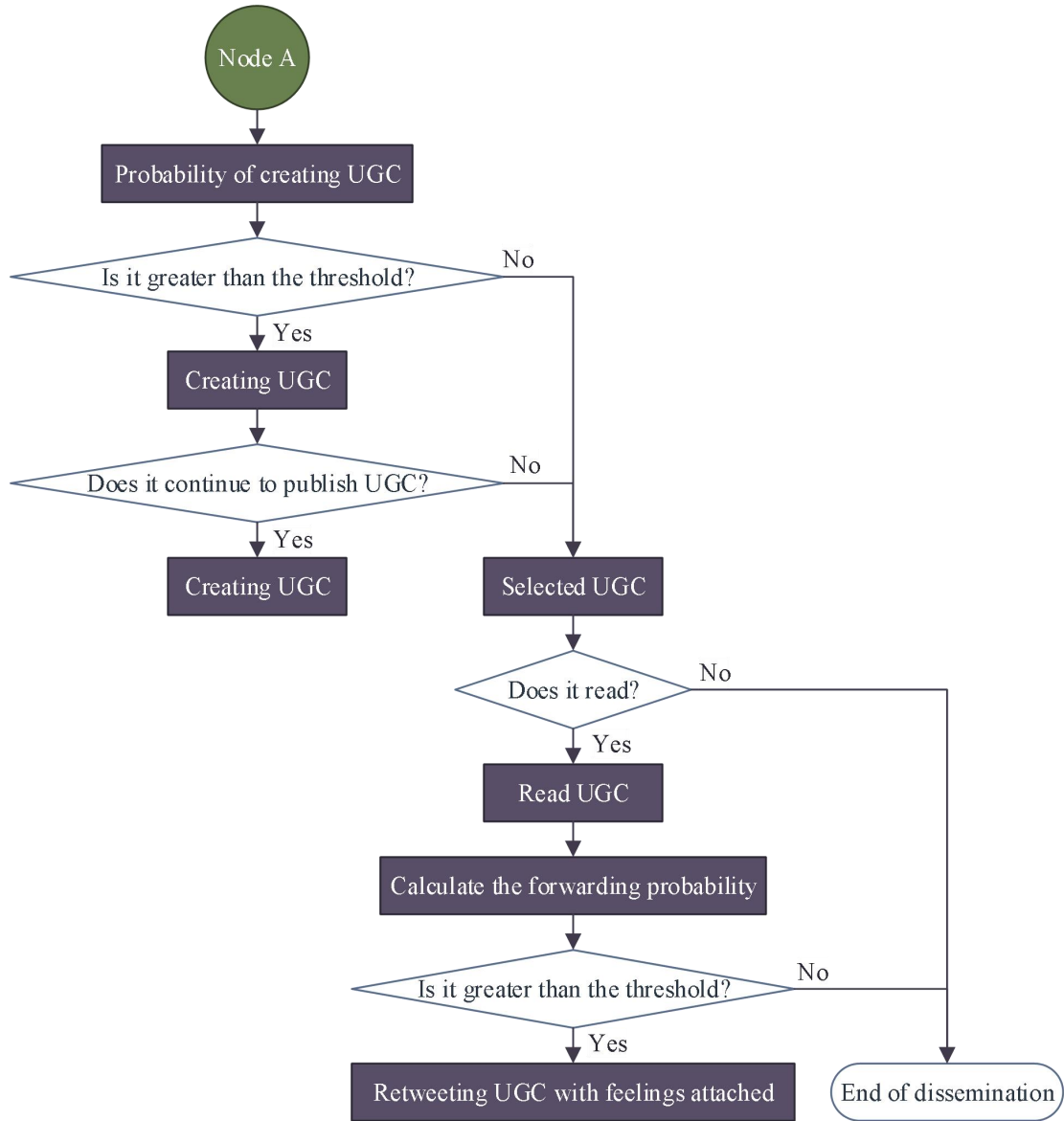


Figure 6. Single-node UGC dissemination process.

3.3.2. UGC communication analysis

This subsection takes Network 1 as the main research object, and obtains 59,964 UGCs and 204,938 events by simulating the UGC propagation on the social network within 20 moments, and analyzes the UGC creation population, UGC propagation characteristics, and UGC propagation cycle distribution data to obtain the overall propagation trend.

The statistics of all UGC retweets on the network show that the top 100 UGCs with the highest retweets occupy all UGC retweet events. In order to save time and resources, this paper selects the representative top 100 UGCs with the highest forwarding volume to analyze the propagation law.

(1) Analysis of UGC creation population

Through the statistics of the number of UGC created by different user groups of all UGCs and the top 100 UGCs with the highest forwarding amount in the structure of network 1. The percentage of different user groups creating UGC is shown in Table 7. It can be seen that core contributors occupy the vast majority of UGC creation in the whole network, amounting to 56.33%, and in the top 100 UGCs with the highest retweeting volume core contributors have a creation volume of 53. Secondly, active participants occupy 32.07% of the contribution volume. The UGC contribution of both groups, core contributors and active participants, has reached 88.4% of the whole network. And this value is more obvious in the UGC with top 100 retweets (94%). In addition, from the user type setting conditions, it can be seen that the number of core contributors accounts for 5% of the total number of people on the whole network, and

active participants account for 10% of the total number of people on the whole network, i.e., 15% of the people create 90% of the UGC, which indicates that a large number of UGC is created by a small number of users, which is in line with the real network rules nowadays.

Table 7. Percentage of UGC created by different user groups.

Type	Whole UGC		Top 100 UGC	
	Quantity	Proportion(%)	Quantity	Proportion(%)
Core Contributors	33776	56.33	53	53
Active participant	19232	32.07	41	41
Regular Participant	6641	11.07	5	5
diver	315	0.53	1	1

(2) Characterization of UGC dissemination

In this paper, propagation speed, propagation range, propagation distance and propagation persistence are selected to express UGC propagation characteristics. The calculation rule of propagation speed is: the moment when UGC is forwarded for the first time minus the moment when UGC is created. The calculation rule of spreading range is: the number of users who forwarded the UGC when it was forwarded for the first time. The calculation rule of propagation distance is: for every user that UGC is forwarded by, i.e., passes through a user, the propagation distance is added by one. Propagation persistence is calculated by subtracting the moment when the UGC was last forwarded from the moment when it was first forwarded.

The propagation characteristics of the top 100 retweeted UGCs are shown in Table 8. It can be seen that the UGCs with top 100 retweets are all retweeted in a relatively short period of time, and the range is small when they are retweeted for the first time, and the propagation speed and the propagation range are kept at a stable level. Observing the propagation speed, the UGC users of the top 100 retweets are very responsive, basically they will be retweeted immediately after creation, and at the slowest, they will be retweeted after only experiencing a moment. Observe the spread range, the maximum value is 6, the minimum value is 1, the average value is 1.5514, the standard deviation is relatively small, it can be seen that the UGC of the top 100 retweets is not aimed at a wide range of users, and the range of first-time retweets is small. Observe the propagation distance, the difference between the minimum value and the maximum value is large, and the standard deviation is large, which indicates that the fluctuation is large, and the external influence factors are large. Observe the propagation persistence, which represents the influence of the discussion degree of the existence of the information, the ups and downs are higher and unstable, indicating that the changes are also larger for different UGC.

Table 8. Spread characteristics of the top 100 UGCs forwarded.

Spread characteristics	Minimum	Maximum	Mean	Standard deviation
propagation velocity	1	7	0.468	0.2087
promulgation scope	1	6	1.5514	0.6934
distance of dissemination	8	97	55.2107	31.7828
Spread persistence	3	33	14.3866	10.8371

The dissemination results of the top 100 UGCs in terms of retweets are shown in Figure 7. The results show that the 67th UGC is the demarcation line between high and low forwarding amount, and the forwarding amount of the top 67 UGCs is not stable, and the forwarding amount of the 67th UGC drops sharply, and the forwarding amount of the last 20 UGCs is lower than 100. As the forwarding amount drops sharply, the spreading distance begins to drop and the floating fluctuation varies a lot. This shows that the UGC with high popularity is more stable in the process of user acquisition and information dissemination, which is in line with the law of dissemination of hot information on social networks nowadays. The UGC with a small amount of retweets is a small circle interaction, so its spread distance is small and unstable.

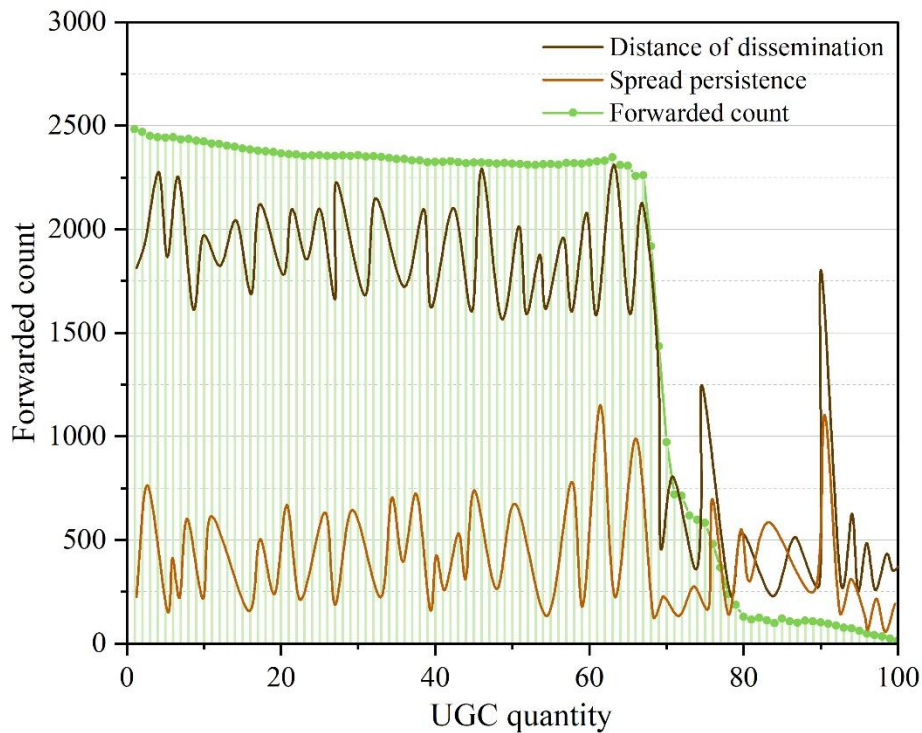


Figure 7. Top 100 UGC sharing results by traffic.

(3) Analysis of UGC communication cycle

The development of each state of affairs is characterized by periodicity, and each cycle corresponds to the corresponding propagation law, which generally contains three states: latent period, outbreak period, and fading period. In order to observe the UGC propagation cycle, this paper analyzes the propagation cycle of UGC with the top 5 retweets.

The propagation cycle of UGC with top 5 retweets is shown in Figure 8. It can be seen that the propagation cycle of UGC with high forwarding volume in the network is generally 4~5, and all of them have experienced latent - outbreak - subside, the outbreak period is generally in the middle of the whole cycle, or in the front position, and rarely appears the phenomenon of staggered backwardness, and the peak propagation volume The peak dissemination volume is above 900 in a single period. UGC with high forwarding volume is prone to trigger the outbreak of public opinion in social networks. Grasping the pattern of the dissemination cycle of UGC with high forwarding volume is a good means for public opinion control and prediction.

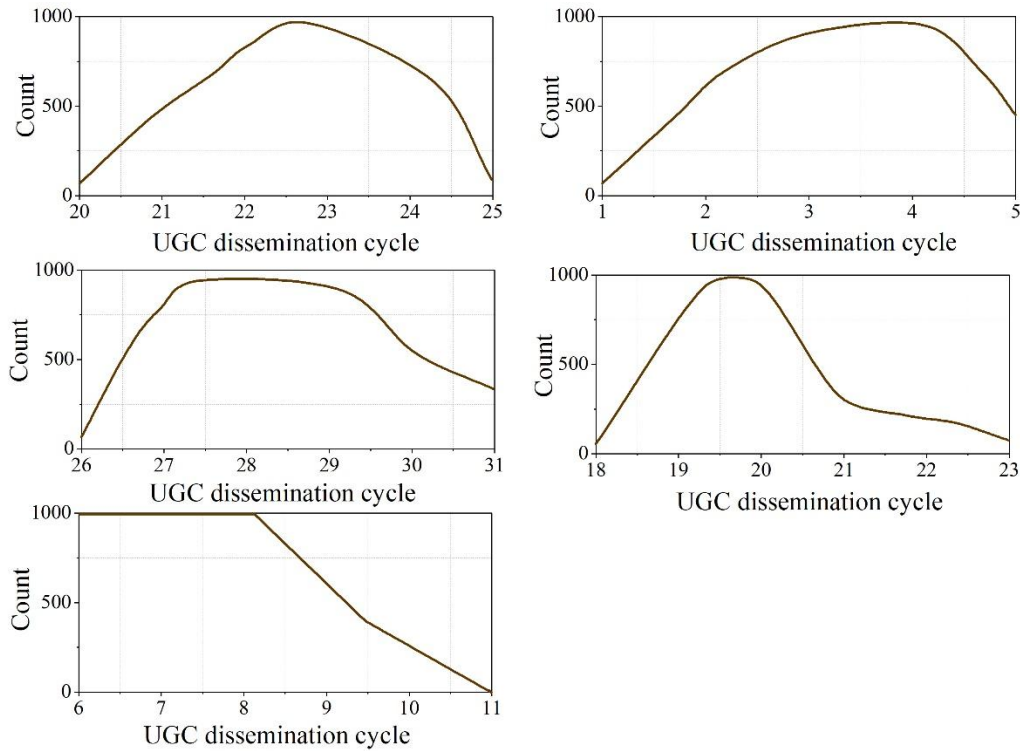


Figure 8. Top 5 UGC dissemination cycles by traffic volume.

4. Conclusion

In this paper, the communication process and characteristics of non-heritage preservation projects in large-scale social media are investigated using the improved SIRI social network information dissemination model and the UGC-based non-heritage short video communication power model. The results are as follows:

(1) Under the effect of two-way interaction between strong and weak relationships, the frequency and probability of information disseminated by individual users being followed, commented on, forwarded, and interacted with by other members of the friend circle are higher.

(2) Easy communicator nodes and communicator nodes have nothing to do with the immunizer coefficient, except that in the process of information dissemination, an increase in the comment coefficient will lead to an increase in the number of comment nodes, and at the same time, more comment nodes will be converted into communicator nodes.

(3) The propagation effect of the non-heritage protection project in the network is influenced by factors such as “node emotion, node control ability, information resource interoperability, network density and distance”.

(4) A large number of UGCs in the current network are created by a small number of users, which is in line with the current real network rules. Moreover, UGC with high forwarding volume is easy to trigger the outbreak of public opinion in social networks, so mastering the law of communication cycle of UGC with high forwarding volume is a good means of control and prediction of NRL protection projects.

However, in addition to the factors such as communication conversion rate, latent conversion rate, and immunity coefficient based on the complex network perspective, which will have a great impact on the efficiency of information dissemination; information dissemination is also related to factors such as the heat of the region and the attractiveness of the original information. However, the origin of many non-heritage conservation projects is relatively remote, and the popularity of the network is low, which leads to many non-heritage projects still can not enter the public's field of vision. In view of this, this paper hopes that the relevant units can pay more attention and financial support to the places of origin of non-heritage protection projects, so that more non-heritage culture can enter the public's field of vision.

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