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# Research on Cultural Exchanges Between China and Countries Along the Belt and Road in the Context of the Internet Infrastructure Development

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**Abstract.** As an important communication channel that transcends history and crosses national borders, culture is not only an important manifestation of a country's soft power, at the same time, international cultural exchanges can also promote the integration and integration of various ethnic cultures. This article combines intelligent computer technology to analyze the cultural exchanges of the Belt and Road in the context of the Internet, and enhance the effect of cultural exchanges through intelligent systems. Moreover, the system constructed in this article is supported by digital technology and acts on new media terminals. In addition, according to the actual needs of cultural communication in the Belt and Road, this article obtains cultural communication data through the Internet to verify the performance of the cultural exchange and communication digital system of this article. Through simulation experiment research, it can be known that the cultural exchange and communication system proposed in this article can effectively promote cultural exchanges in various countries along the Belt and Road.

**Keywords:** Internet; the Belt and Road; countries along the route; cultural exchange
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## 1 INTRODUCTION

The "the Belt and Road" initiative is a great idea put forward by General Secretary Xi Jinping based on the present and focusing on the future. Since its proposal in 2013 and its formal implementation in 2015, three years have passed since the construction of the "the Belt and Road" economic belt. In the past three years, the development and construction of "the Belt and Road" has made remarkable achievements, and it has also attracted the participation of many countries along the road. So far, 64 countries and regions have participated in the construction of "the Belt and Road", covering Asia, Africa and Central and Eastern Europe. The active participation and construction of various countries has allowed "the Belt and Road" to reproduce the grand occasion of the "Silk Road" that year, and will also promote the economic prosperity of participating countries. The successful implementation of "the Belt and Road" proves that China's economic, political and cultural propositions have been recognized and supported by the people of all participating countries and regions. Moreover, it has realized that everyone builds together, communicates and cooperates together, and builds a home together. At the same time, China is taking the responsibility of a major country and actively opening up. The "the Belt and Road" initiative proves that China's "going global" is correct, and it is a great policy that benefits the world and promotes world peace and stability.

At present, China's development is facing a rare historical opportunity, but at the same time it is also facing extremely severe challenges. For example, many Western mainstream media arbitrarily promoted the "China Threat Theory", which once "demonized" China's overall national image. It is self-evident that various negative international public opinions have had a negative effect on the construction of China's national image. This continuous fermentation of international public opinion makes my country still in a passive position in terms of ideology, and the international public opinion field is unable to hold the initiative, which is extremely disproportionate to my country's current international status. Therefore, if we want to break the old and build the new, we need to insist on strengthening the international dissemination and exchange of culture through the communication power of cultural soft power in the promotion of a major strategy with a sense of international social responsibility represented by the "Belt and Road". Actively use media platforms to expand and strengthen external publicity, and master the right to speak. General Secretary Xi Jinping once pointed out that civilization is the source of power for foreign exchanges and the promotion of world peace and development. External development is nothing more than economic trade and civilized exchanges. Economic trade is a manifestation of material exchange, and civilized exchanges are the spiritual manifestation of cultural and ideological exchanges.

This article combines intelligent computer technology to analyze the cultural exchanges of countries along the Belt and Road in the context of the Internet, and enhances the effect of cultural exchanges through intelligent systems.

## 2 RELATED WORK

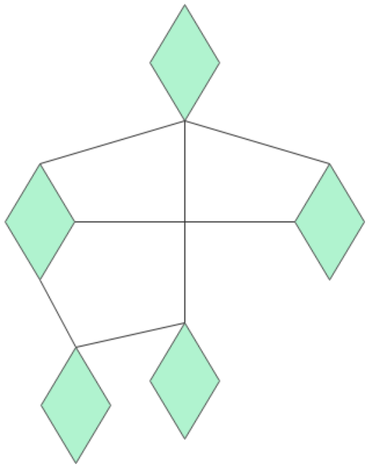
The development of computer technology has promoted research scholars in recent years to explore how to use emerging computing technologies to discover human experience. The social environment and personal experience factors in human-computer interaction technology have shown a trend of profound cultural influence on computer technology. A field closely integrated with human-computer interaction technology has also emerged-cultural computing [1]. Cultural computing is developed on the basis of the prosperity of computer technology such as augmented reality technology and social networking. Specifically, the computer system method is used to build a model of traditional culture so that users can have a cultural interactive experience on today's computer application equipment [2]. These computer technologies provide new ways for the commonality and integration between different cultures [3]. Literature [4] designed an intelligent cultural computer system, an interactive cultural digital processing equipment. The cultural digital processing system provides a guiding user interface to help users create their own imaginary world. The designer hopes to awaken the user's potential imagination of daily life through the process of digital creation. The currently designed cultural computing system re-displays traditional culture in new spatial dimensions and media. Based on this day, the main characteristics of the current cultural computing system are summarized: (1) Visual technology; (2) Social interaction; (3) Bit Literature; (4) Cultural cross [5]. These characteristics are derived from the definition of culture itself, focusing on the relationship between culture and human social activities, and thinking that the essence of culture is the way human beings behave in learning and life. Literature [6] starts from the development process of human-computer interaction technology, and emphasizes the characteristics of cultural computing, a new subordinate branch of human-computer interaction technology: (1) The "disappearance" of computer entities; (2) The user experience is strengthened; ( 3) The construction of network communities. Believe that cultural computing is not just simply adding cultural factors to the interactive experience, but also enables users to get closer to the core connotation of the culture where they are in the experience, and then use their own culture as a foundation to enrich the development of infrastructure in the digital age.

Research on the digital technology level of intangible cultural heritage has achieved some results. UNESCO develops the inheritance and protection of the intangible cultural heritage of different countries around the world. In the Korean National Music Museum, the production, history and characteristics of musical instruments are displayed in detail using projection television [7]. American Memory, a digital online library in the United States, permanently archives American cultural and cultural data. The Memorial University of Newfoundland, Canada (Memorial University) showcases traditional basket-making craftsmanship on its intangible cultural heritage website, and encourages online audiences to upload photos to showcase their own baskets[8]. The website of British traditional basket crafts is linked to the personal website of the inheritor of basket memory. Researchers in the European Union have designed "Locating London's Past" (Locating London's Past)-an interactive map-style website that personalizes London's culture to online audiences [9]. The launch of Google’s smartphone application GoogleGoggles connects the collection of cultural art with mobile terminals. This application allows instant capture of images and searches for information and links related to images in a short period of time. The Metropolitan Museum of New York actively joins Google’s initiative. One project. When and where the mobile phone user encountered a replica similar to the museum's collection, but without knowing the specific information, he could get the answer through his mobile phone. This application can directly access the official website of the Metropolitan Museum in New York by shooting this work to obtain information about this work. The touch screen tablet iPad's online application store has launched a knitting technique application (Handicraft), and participants who provide the application can make their own knitting works through the touch screen [10]. Researchers of intangible cultural heritage also extend the digital technology of intangible cultural heritage to virtual three-dimensional scenes [11]. The use of digital technology in historical and cultural content has not only played a role as a tool to transform non-digital historical information into digital products. Cultural heritage as content, including intangible cultural heritage, is being integrated with digital technology [12]. The current common forms of these converted digital products include visual presentation of multimedia terminals, electronic games, web pages, and online communities. The important audience of historical and cultural content is the young group in society, which is also a large number of participants in video games. Therefore, in the study of the integration of cultural heritage content and digital technology, some scholars have tried to explore the ways of combining electronic games and cultural heritage from different aspects [13]. The cultural content contained in digital technology should be studied and analyzed in the cultural and historical environment of the entire society [14]. Most digital content is aimed at tangible cultural heritage, and the proportion of digital research in the field of intangible cultural heritage is relatively low. Most of the research on intangible cultural heritage revolves around how to apply digital technology to the field of intangible cultural heritage, such as 3D modeling technology, Internet technology, virtual reality technology, etc. [15]. On the other hand, starting from the value of culture itself, exploring the social attributes of culture, integrating culture and technology, and using the perspective of cultural computing to conduct digital research on intangible cultural heritage [16]

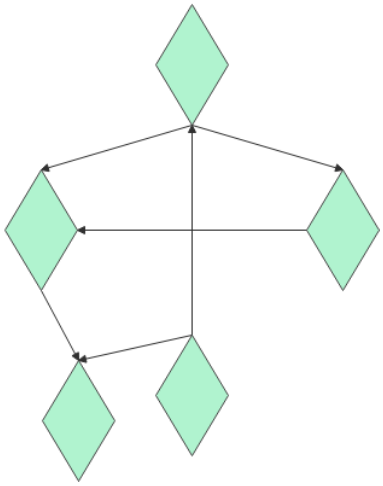
## 3 CULTURAL EXCHANGE AND COMMUNICATION ALGORITHM BASED ON COMPLEX SOCIAL NETWORK

This article mainly adopts the analysis method of complex network to analyze the structural characteristics of several real social networks to reveal the social phenomena contained therein. On this basis, it explores the establishment mechanism of "social relations" between social individuals, and designs corresponding and more accurate link prediction algorithms.

Generally speaking, a network is represented by a set of nodes V and a set of edges E, which is denoted as G(V,E). Among them, the node set is $V=\{v_1,v_2,v_3,\cdots,v_N\}$ , the edge set is $E=\{e_1,e_2,e_3,\cdots,e_M\}$ the total number of nodes in the network is $N=|V|$, and the total number of edges is $M=|E|$. Each edge $e_i(i=1,2,3,\cdots M)$ in E has a unique pair of nodes $(v_i,v_j)$ corresponding to it in V. Among them, nodes can represent specific people, things, things, places, web pages, etc., and edges can represent the association relationship between corresponding nodes. Figure 1(a) and figure 1(b) show a simple schematic diagram of an undirected network and a directed network, respectively. Both networks in the figure contain five nodes and six edges, but each edge in figure 1(b) has a direction.



(a)



(b)

**Figure 1:** Simple examples of directed and undirected networks.

(a) Simple undirected network diagram (contains five nodes and six undirected edges)
(b) Simple diagram of a directed network (contains five nodes and six directed edges)

Figure 2 shows a path of length 3 in black. The average distance of the network is an important index to describe the characteristics of the network topology. The famous "six degree separation theory" is to describe the average distance of the network-on the earth, two people are randomly selected, and they can get in touch with each other only through 5 people on average. It is defined as[17]:

$$\langle d\rangle=\frac{1}{N(N-1)}\sum_{i\neq j}d_{ij} \tag{1}$$

In the formula, $d_{ij}$ represents the "shortest path" between node $i$ and node $j$, which is defined as the path with the shortest length among all the paths of the two, also known as the "geometric path".

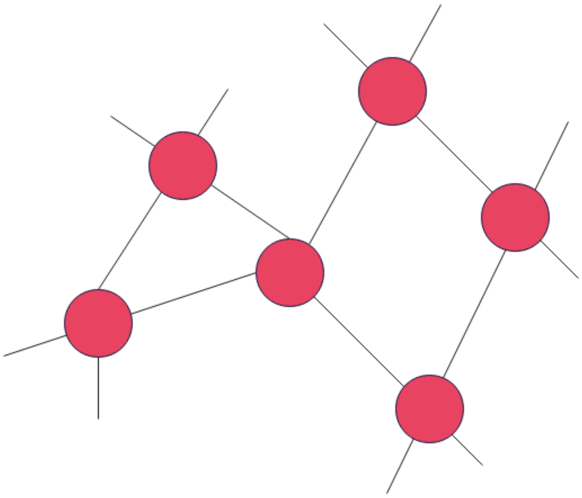


**Figure 2:** Schematic diagram of a path of length 3 (the path is emphasized in black).

Another concept of path is the "diameter" of the network. It is generally defined as the length of the longest "shortest path" between all reachable nodes for a connected network or connected branch (in a disconnected network, there is no reachable path between some nodes). It is usually used to measure the speed and quality of information dissemination in the network. It is defined as:

$$D = \max_{1 \le i, j \le N} d_{ij} \quad (2)$$

Figure 3 shows a disconnected network. The network contains two extremely connected branches A and B, where B is the giant branch of the network.

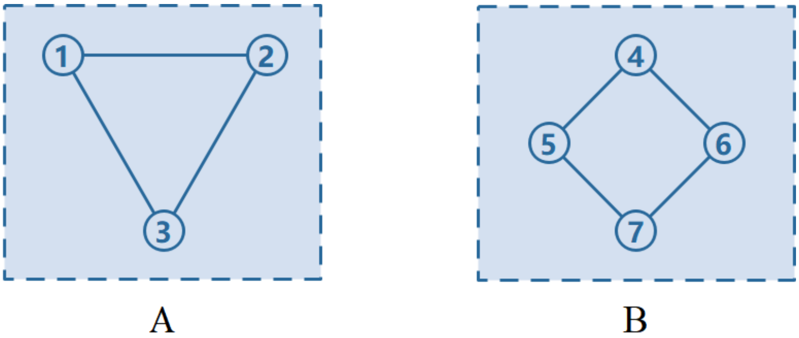



**Figure 3:** Schematic diagram of the maximal connected branch.

As shown in Figure 3, the disconnected network contains two branches A and B. In branch A, the number of nodes is 3. The number of nodes in the B branch is 4. Therefore, B is a huge branch of the network.

In an undirected network, the degree of the node $i$ represents the number of all the edges connected to the node, denoted as $k_i$. In network analysis, the algorithm usually evaluates the basic structure of the network as the first step. The average degree is the most commonly used indicator, which is defined as the average of the sum of the corresponding degrees of all nodes in the network, that is:

$$\langle k \rangle = \frac{1}{N} \sum_{i=1}^{N} k_i \tag{3}$$

$p(k)$ is the proportion of nodes with degree k in the network. It can also be understood as the probability that a node is randomly selected and its degree is equal to k, then the distribution of $p(k)$ is the degree distribution of the network. "Clustering coefficient" is a commonly used index to describe the strength of clustering between network nodes. The clustering coefficient of node $i$ can be expressed as[18]:

$$C_i = \frac{2M_i}{k_i \left(k_i - 1\right)} \tag{4}$$

Among them, $k_i$ represents the degree of node i, and $M_i$ represents the number of edges between other nodes that are neighbors to node i. In particular, when k=1, it indicates that the node has only one neighbor, and its clustering coefficient is 0 by default. When it is necessary to express the clustering characteristics of the entire network, the "average clustering coefficient" C is usually used to describe it, which is defined as the mean value of the sum of the clustering coefficients of all nodes, as shown below:

$$C = \frac{1}{N'} \sum_{i, k_i > 1} \frac{2M_i}{k_i \left(k_i - 1\right)} \tag{5}$$

In the formula, $N'$ represents the number of nodes with degree greater than 1.

1. Degree Centrality

Degree centrality (Degree) is one of the easiest ways to measure the importance of network edges. The degree centrality of edge $e = (i, j)$ is defined as the product of the degrees of the two endpoints:

$$D_e = k_i k_j \tag{6}$$

In the formula, nodes i and j are the two end points of edge e, and $k_i$ and $k_j$ respectively represent their corresponding degrees. Generally speaking, the greater the degree, the more important the edge.

2. Betweenness centrality

In the network, if the number of shortest paths passing through an edge increases, the edge is naturally more important. Betweenness centrality (Betweenness) is proposed based on this, and the betweenness centrality of an edge e is defined as:

$$C_e = \sum_{s,t \in V, s \neq t} \frac{\sigma(s,e,t)}{\sigma(s,t)} \tag{7}$$

Among them, $\sigma(s,t)$ represents the total number of shortest paths existing between node s and node t, and $\sigma(s,e,t)$ represents the total number of shortest paths passing edge e in the shortest path between node s and node t.

3. Bridge coefficient

Bridgeness is proposed by Cheng et al. According to the concept of maximally connected subgraphs in the network, it can effectively measure the effect of connecting edges on maintaining network connectivity. The bridge coefficient of edge $e=(i,j)$ is defined as:

$$B_e = \frac{\sqrt{S_i S_j}}{S_e} \tag{8}$$

Among them, i and j are the two endpoints of edge e, $S_i$ and $S_j$ respectively represent the number of nodes in the maximum complete subgraph where node i and node j are located, and $S_e$ represents the number of nodes in the maximum complete subgraph where edge e is located.

Figure 4 is a network with an obvious community structure. It can be seen from the figure that the edges between the red, green, blue, and yellow nodes are very sparse, while the edges within each of them are relatively tight.

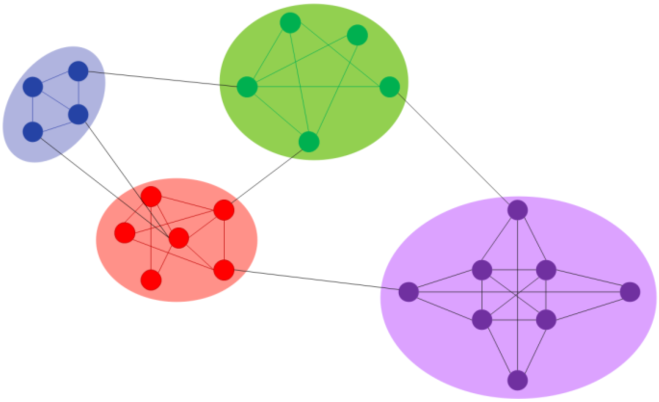


**Figure 4:** A network diagram with an obvious community structure (the color of the node represents the community to which it belongs).

In order to evaluate the pros and cons of the above community division algorithm, this section will introduce two evaluation indicators: modularity and adjusted Rand index. They are often used in multiple research fields of complex networks. Among them, the Rand index often appears in research in the field of machine learning to judge the classification effect of algorithms.

1.Modularity

The modularity $(Q)$ is mainly used to evaluate the pros and cons of the community partition algorithm. It refers to the difference between the proportion of edges belonging to the same community in the target network and the expected value of the proportion of edges belonging to the same community in the random network. The calculation method is as follows[19]:

$$Q=\frac{1}{2M}\sum_{vw}\left(A_{vw}-\frac{k_v k_w}{2M}\right)\delta\left(c_v,c_w\right) \tag{9}$$

In the formula, M represents the total number of connected edges in the network. When there is an edge between node v and node w, $A_{vw}=1$, otherwise, it is 0. $\delta\left(c_v,c_w\right)$ is a Kronecker function. When node v and node w are in the same community, $\delta\left(c_v,c_w\right)=1$, otherwise, it is 0. The range of Q value is [-0.5,1). The closer the value is to 1, the better the classification effect of the algorithm. Generally speaking, when the Q value is between 0.3 and 0.7, it indicates that the clustering effect is already very good.

2. Rand Index

The Rand Index is an index used to evaluate the similarity of the results of each community division algorithm. When the category information divided by the algorithm is H and the clustering result is K, the Rand index can be calculated as:

$$RI=\frac{a+b}{C_2^{n_{\text{samples}}}} \tag{10}$$

Among them, a represents the logarithm of elements that belong to the same category in H and K, b represents the logarithm of elements that belong to the same category in H and K, and $C_2^{n_{\text{samples}}}$ represents the total logarithm that can be formed between two or two elements in the data set. The value range of RI is [0,1], and the closer to 1, the more similar the division result of the algorithm is to the known result. Under normal circumstances, in order to make the result more discriminative, the adjusted Rand index is generally used, as shown below:

$$ARI=\frac{RI-E\,|\,RI\,|}{\max(RI)-E\,|\,RI\,|} \tag{11}$$

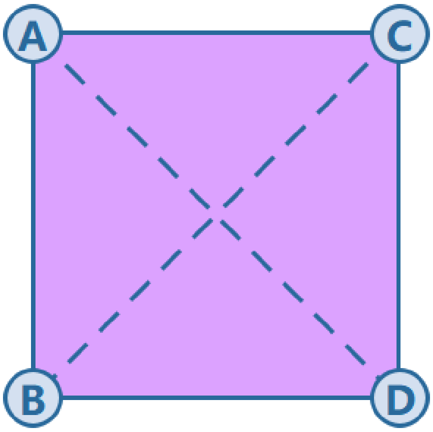



**Figure 5:** Schematic diagram of link prediction.

As shown in Figure 5, the solid lines indicate the edges that exist in the network, and the dotted lines indicate the edges that do not exist in the network. For a certain link prediction algorithm, it is necessary to calculate the scores corresponding to the edges that do not exist in the network.
In the link prediction algorithm, the definition of similarity between nodes determines whether the algorithm can well grasp the topological structure characteristics of the target network. Generally speaking, if two nodes have more neighbors in common, the degree of similarity between them is higher. Therefore, among the algorithms based on local information, algorithms based on common neighbor similarity are the most commonly used in social network analysis, including Jaccard algorithm, Salton algorithm, Sørenson algorithm, etc. Their specific introduction is as follows:

1. Jaccard algorithm

The Jaccard similarity algorithm is derived from the Jaccard similarity coefficient, which was proposed by Jaccard in 1901. It is often used to compare the similarity between two different sample sets. In the prediction algorithm, it is generally believed that if two nodes have more co-dominations, the higher their similarity, the easier it is to have edges. Based on this idea, combined with the Jaccard similarity coefficient, the similarity score between target nodes can be defined as:

$$S_{xy}^{\text{Jaccard}} = \frac{|\Gamma(x) \cap \Gamma(y)|}{|\Gamma(x) \cup \Gamma(y)|} \tag{12}$$

Among them, $\Gamma(x)$ represents the set of neighbors of node x, the numerator represents the number of nodes that are the same neighbors of node x and node y, and the denominator represents the total number of neighbors of node x and node y.

2. Salton algorithm

Based on the idea of common neighbor, the Salton algorithm takes the influence of the target node degree into consideration. In addition, it draws on the calculation method of cosine similarity to measure the similarity between nodes. The algorithm is defined as:

$$S_{xy}^{\text{Salton}} = \frac{|\Gamma(x) \cap \Gamma(y)|}{\sqrt{k_x k_y}} \tag{13}$$

In the formula, $k_x$ represents the degree of node $x$.

3. Sørenson algorithm

Similar to Salton's algorithm, Sørenson's algorithm also considers the impact of common neighbors and target node degrees. It just changes the way of measuring the influence of the target node degree from the square root of the product to a simple sum of degrees. It is often used in data science research related to ecology, and its definition is as follows:

$$S_{xy}^{\text{S?renson}} = \frac{2 \times |\Gamma(x) \cap \Gamma(y)|}{k_x + k_y} \tag{14}$$

4. Generous Node Benefit Algorithm (HPI)

As the name suggests, Hub promoted index (HPI) believes that nodes with a high degree are more likely to have edges with other nodes in the network. It is often used to describe the similarity between different reactants in the metabolic network of an organism, and it is expressed as:

$$S_{xy}^{\text{HPI}} = \frac{|\Gamma(x) \cap \Gamma(y)|}{\min\{k_x, k_y\}} \tag{15}$$

It can be seen from the definition that the denominator is only determined by nodes with small degrees. Therefore, a node with a higher degree always has a higher similarity with other nodes in the network.

5. Large node disadvantageous algorithm (HDI)

The HDI algorithm is just the opposite of the HPI algorithm, and its denominator is determined by the node with a large degree. Under this definition, it can be seen that it is easier to establish an edge relationship between a node with a small degree and other nodes in the network, and it is defined as:

$$S_{xy}^{\mathrm{HDI}} = \frac{|\Gamma(x) \cap \Gamma(y)|}{\max\left\{k_x, k_y\right\}} \tag{16}$$

In the above-mentioned several link prediction algorithms based on local information, it is considered that neighboring nodes have the same contribution to whether there is a connection between the target nodes. However, this is often not the case in practice. The link prediction algorithm based on the naive Bayes model is referred to as LNB, and its specific definition is:

$$S_{xy}^{\mathrm{LNB}} = \frac{P(A_1)}{P(A_0)} \prod_{w \in O_{xy}} \frac{P(A_0) \cdot P(A_1 | w)}{P(A_1) \cdot P(A_0 | w)} \tag{17}$$

Among them, $O_{xy}$ is the set of common neighbors between node x and node y, $P(A_1) = \frac{2M}{N(N-1)}$ represents the probability of connecting edges between them, then $P(A_0) = 1 - \frac{2M}{N(N-1)}$ represents the probability that there is no connecting edge between the two target nodes. $P(A_1 | w)$ represents the probability that the neighbors of node w are connected to each other, and $P(A_0 | w)$ represents the probability that the neighbors of node w are disconnected from each other.

Compared with the link prediction algorithm based on local information, the path-based link prediction algorithm has become more complicated because it considers the path information, and its efficiency is generally lower than other link prediction algorithms. This section will introduce three path-based link prediction algorithms, namely Katz algorithm, local path algorithm and LHN-II algorithm.

1.Katz algorithm

In order to consider the structural information of the network more, the Katz algorithm is defined as:

$$S_{xy}^{\mathrm{Katz}} = \sum_{l=1}^{\infty} \alpha^l \cdot \varphi(x, y, \langle l \rangle) \tag{18}$$

In the formula, l represents the length of the path, $\alpha$ is an adjustable parameter, which is used to control the weight of the path in the network, and $\varphi(x, y, \langle l \rangle)$ represents the total number of paths with length l between node x and node y.

2.Local path algorithm

Based on the idea of Katz algorithm, the definition of local path algorithm is as follows:

$$S = A^2 + \alpha \cdot A^3 \tag{19}$$

Among them, $\alpha$ is also an adjustable parameter, and A represents the adjacency matrix corresponding to the network.

3.LHN-II algorithm

The LNH-II algorithm ignores whether the target node directly has a common neighbor. As long as their neighbor nodes are similar, the target node is considered to be similar, as shown below:

$$S = \gamma (I - \gamma A)^{-1} \tag{20}$$

Among them, $\gamma$ is a global constant, which is usually set to 1, and I is the identity matrix.
They are the global ACT algorithm and the LRW local random walk algorithm that only considers a finite number of steps. Their specific calculation methods are as follows:

1. ACT algorithm

The ACT algorithm is a random walk algorithm that considers the overall situation, and it is defined as:

$$S_{xy}^{\mathrm{ACT}} = \frac{1}{l_{xx}^{+} + l_{yy}^{+} - 2l_{xy}^{+}} \tag{21}$$

In the formula, $l_{xy}^{+}$ represents the element in the x-th row and y-column of the pseudo-inverse $L^{+}$ of the Laplacian matrix L=(L=D-A) of the network. In the expression of Laplacian matrix L, D represents the degree matrix of the network.

2. Local random walk algorithm (LRW)

The local random walk algorithm is referred to as the LRW algorithm. Compared with the random walk algorithm that considers the overall situation, the LRW algorithm has higher efficiency in some cases, as shown below:

$$S_{xy}^{\mathrm{LRW}} = q_x \cdot \pi_{xy}(t) + q_y \cdot \pi_{yx}(t) \tag{22}$$

Among them, $q_x$ represents the distribution of resources owned by each node in the initial state, t represents the number of random walk steps, and $\pi_{xu}(t)$ represents the probability of node x reaching node y after t steps.
The full name of AUC is Area Under the Receiver Opearting Characteristic Curve, which is the most commonly used evaluation indicator in social network analysis. The most accurate way to calculate AUC is to compare all edges in the test set with edges that do not exist. If the score of an edge in the test set is greater than the score of an edge that does not exist, the AUC is increased by 1. If the two are equal, AUC is added 0.5. Therefore, the total number of comparisons is $n = \left|E^P\right| \cdot |U - E|$. We assume that the score of the edge in the $n'$ test set is greater than the score of the non-existent edge, and the score of the edge in the $n''$ test set is equal to the score of the non-existent edge. Then, AUC can be calculated as:

$$\mathrm{AUC} = \frac{n' + 0.5n''}{n} \tag{23}$$

When the network scale gradually increases, if all possible edges are compared, the number of comparisons n will reach tens of millions, or even hundreds of millions, and the calculation efficiency is extremely low. Therefore, in actual research, it usually randomly selects an edge from the test set. At the same time, the algorithm randomly selects an edge from the set of edges that does not exist, and compares the scores of the two. The algorithm repeats the above sampling. When the number of samples reaches 672,400, it can be guaranteed with a 90/% confidence that the absolute error between the approximate AUC value and its precise value does not exceed one-thousandth. In this way, the computational complexity can be greatly reduced.

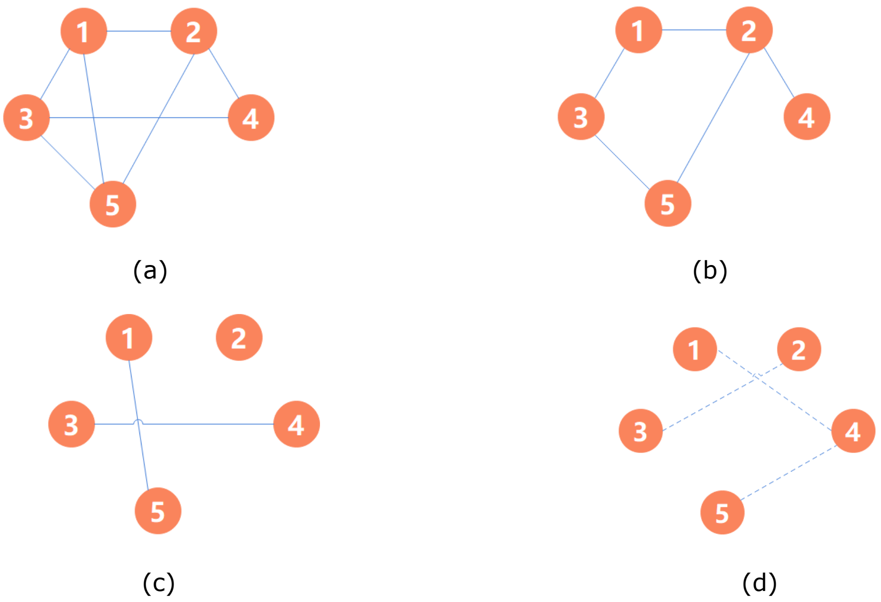



**Figure 6:** Schematic diagram of the calculation process of AUC.

(a) The original network diagram (including five nodes and seven edges);
(b) The training set obtained by random sampling (including five edges);
(c) The test set obtained by random sampling (including two edges);
(d) Schematic diagram of non-existent edges (including three edges).

Figure 6 shows an example of calculating the AUC value under a specific link prediction algorithm. Figure 6(a) shows the original network diagram, which contains five nodes. If there are connected edges between any two nodes in the network, the number of possible edges is ten. There are seven edges that actually exist in the graph. Therefore, there are three edges that do not exist. It can be seen from the figure that $\bar{E} = \{(1,4),(2,3),(4,5)\}$.

1. Accuracy

The quality of each algorithm can be evaluated by precision, which is defined as:

$$Precision = \frac{m}{L} \tag{24}$$

In the formula, L represents the connected edge corresponding to the top L in the prediction result, and m represents the connected edge in the top L, of which m connected edges belong to the test set.

2. Sorting points

The ranking score is slightly different from the previous two. It considers the ranking of all the edges in the test set in the final result, and it is defined as:

$$\mathrm{RS} = \frac{1}{\left|E^P\right|} \sum_{e \in E^P} \frac{r_e}{\left|E^P \cup \bar{E}\right|} \tag{25}$$

Among them, $r_e$ table edge e ranks in the prediction result. According to the above formula, the order of the calculation example shown in figure 6 is divided into $\mathrm{RS} = \frac{1}{2} \times \left(\frac{1}{5} + \frac{3}{5}\right) = 0.4$.

## 4 THE CULTURAL EXCHANGE SYSTEM BETWEEN CHINA AND THE COUNTRIES ALONG THE BELT AND ROAD IN THE CONTEXT OF THE INTERNET

In the modern information society, the digitization of product images has changed the way audiences perceive brands and obtain product information. Russwell, the founder of communication studies, believes that the communication process must include the main body of communication, the content of communication, the object of communication, the method of communication and the effect of communication. These are the five elements of a complete communication process. As for new media communication, the dissemination of culture covers the process from content to form, and from channels to audiences. Figure 7 summarizes the cultural communication system. This communication system is supported by digital technology, acts on the terminals of new media, and gives audiences unprecedented power. At the same time, it makes people not only passively accept the information of product advertisements, but actively participate in the interaction.

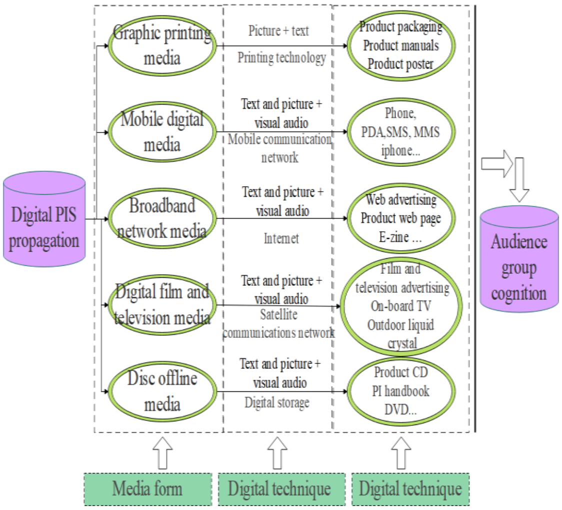



**Figure 7:** The communication system of digital culture.

The production of cultural communication products is carried out through multimedia technology. The general production process of multimedia products is shown in Figure 8.

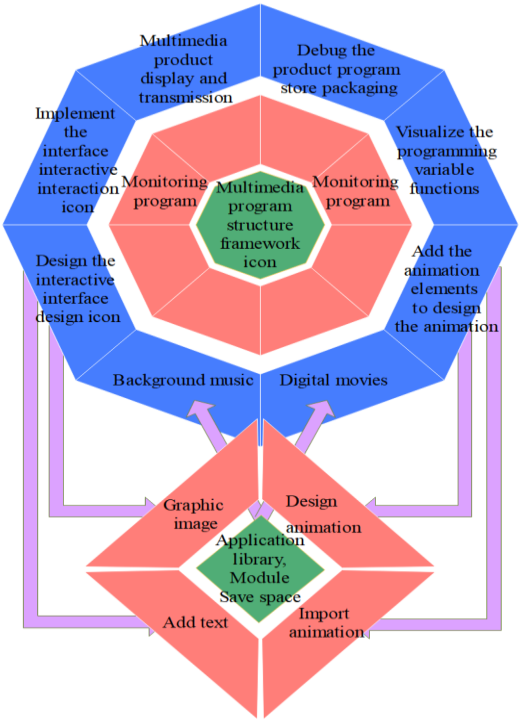
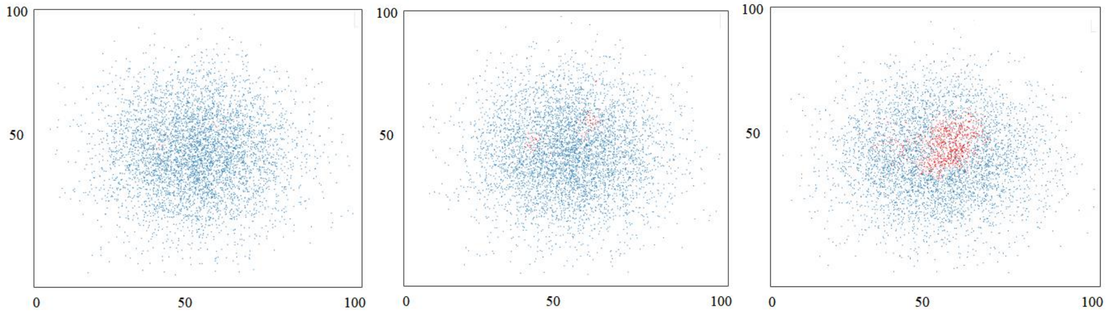



**Figure 8:** The general production process of multimedia cultural products.

On the basis of the above research, according to the actual needs of cultural communication in the countries along the Belt and Road, this article obtains cultural communication data through the Internet. Moreover, this article verifies the performance of the cultural exchange and communication digital system of this article, and counts the simulation diagrams of cultural exchange and communication, and obtains the results shown in Figure 9.




(a) Cultural involvement (b) ) Cultural exchange (c) Cultural integration

**Figure 9:** Simulation diagram of cultural exchange and communication.

Through the above simulation test research, it can be seen that the cultural exchange and communication system proposed in this article can effectively promote the cultural exchange of various countries in the Belt and Road, and play an important role in promoting the further development of the Belt and Road.

## 5 CONCLUSION

The Belt and Road is an important way for Chinese civilization to spread internationally, and it has played a very important role in spreading Chinese culture. This paper takes the the Belt and Road initiative as the basic perspective, and analyzes the status quo of the external communication of Chinese culture based on the practice of the "the Belt and Road" initiative. At the same time, this article explores the problems in the external communication of Chinese culture and proposes corresponding countermeasures to solve the dilemma of external communication, which has certain practical guiding significance, and also provides relevant theoretical support for the external communication of Chinese culture. With the continuous development of economic globalization, the occurrence of economic activities is no longer an independent event, and the factors affecting economic activities have become complex and changeable. With the development of international trade on a global scale, the economic ties of various countries have become increasingly close, and trade has become an important pillar to promote the economic growth of various countries, which is particularly prominent in China. On the surface, trade activities show an increase or decrease in cross-border trade flows, but they are actually affected by multiple factors such as geography, system, and culture. Through simulation experiment research, it can be seen that the cultural exchange and communication system proposed in this article can effectively promote the cultural exchange of various countries in the Belt and Road.

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