


Research Article

The Construction Method of Historical Geographic Information System Based on Mobile Network

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The research of historical geography is inseparable from the construction of historical geographic information systems, but the traditional construction method of historical geographic information systems has certain technical defects in the storage, management, analysis, and data sharing of historical geographic data. Therefore, more innovative and advanced construction methods of historical geographic information systems are needed to continuously improve the construction of historical geographic information systems, to promote the development of historical geographic information research. In contemporary society, a more excellent historical geographic information system construction method is inseparable from the support of science and technology. With the continuous development of science and technology, mobile network technology has emerged. As a combination of mobile communication and the Internet, mobile network has strong functional advantages. It has developed rapidly in recent years and has great market development potential. This paper aims to study the construction method of historical geographic information systems based on mobile network. Combined with the data collection algorithm of mobile network, the historical geographic information system construction experiment was carried out. The experiment concluded that the information integrity of the historical geographic information system constructed based on the mobile network is 18.2% higher than that of the historical geographic information system constructed using traditional methods. This shows that mobile network technology has a certain positive effect on the construction of historical geographic information systems.

1. Introduction

Historical geographic information system is an information system that can integrate all kinds of information and resources related to history and geography for visual display. In the research of historical geography, the information data support provided by the historical geographic information system is inseparable. Therefore, the construction of a historical geographic information system is an indispensable part of historical geographic research. However, due to the lack of technology in the traditional historical geographic information system construction method, there are problems in data analysis and sharing in the construction of historical geographic information systems. This is not

conducive to the development of historical geography research. Therefore, for the research of historical geography, more innovative and technologically superior methods of constructing the historical geographic information system are needed. It promotes the continuous improvement of the historical geographic information system, thereby promoting the development of historical geographic research. With the continuous progress of today's science and technology, there are increasing technologies and methods that can help the construction of historical geographic information systems. For example, the mobile network is the product of the combination of mobile communication and the Internet, and it is an innovative wireless network service technology. Mobile communication technology realizes the

desire to communicate with each other without being limited by time, space, and place. The Internet enables people to easily access massive network resources and conduct network communication anytime, anywhere. Therefore, the mobile network, which combines the two, has powerful functions of network communication and network resource acquisition at the same time. Today, with the proliferation of mobile terminal devices including cell phones, PDAs, or other portable tools, mobile networks do not require desktop computers. This makes it possible to directly connect to the public network without the need for a fixed connection device, to meet people's more convenient Internet access needs. In recent years, the development of mobile networks has become increasingly rapid. It has been widely used in increasing industries and has good market development potential.

The innovations of this paper are as follows: (1) it discusses the construction method of historical geographic information system in combination with mobile network technology; (2) it combines the data collection algorithm of mobile network to carry out the construction experiment of historical geographic information system based on traditional construction method and mobile network technology, respectively. It also draws effective conclusions through the comparison of the information integrity test results of the two construction systems.

2. Related Work

Many researches related to mobile networks have also emerged in the academic world today. Among them, Zhang et al.'s research improves the flexibility and capacity of network resource allocation in mobile network slicing by exploring effective resource allocation schemes. They proposed a scheme to manage the mobility between different access networks [1]. Chen et al.'s research mainly focuses on the security access problem of mobile networks. In their own research, they proposed a batch identification game model in wireless mobile networks that can improve the security and encryption performance of mobile network login authentication [2]. The study by Prados-Garzon et al. proposes a theoretical framework to evaluate long-term evolution virtualization management techniques for mobile networks. They also verified the effectiveness of the framework through mathematical model simulations [3]. Pérez et al.'s research proposes a 5G network-oriented solution to the problem of botnets affecting the continuity of mobile network services. They also verified through experiments that the scheme can detect and mitigate the threats caused by botnets on mobile networks [4]. The study by Cao et al. proposes a device-to-device communication-assisted mobile traffic offloading scheme. They effectively increase mobile network capacity and mitigate traffic by offloading traffic and utilizing complementary network communication technologies [5]. Zeng et al.'s research proposes an adaptive scheduling mechanism based on self-similarity to improve mobile network connectivity. They also verified the effectiveness of the mechanism through a large number of tracking-driven simulation experiments [6]. These studies are closely related

to mobile network technologies, which provide a method and technical references for the research of this paper.

3. Construction Method of Historical Geographic Information System

3.1. Mobile Network

3.1.1. Concept. In a broad sense, mobile network refers to the combination of mobile communication and the Internet, using laptops or other mobile terminals to access the mobile network to provide users with mobile communication services and Internet services. In a narrow sense, it refers to the use of smart phone terminals [7]. Contemporary mobile Internet access devices, such as smart phones, tablet computers, and other portable terminal devices, all obtain information resources required by users in real time through wireless networks such as GPRS and WiFi. With the development of mobile networks, the coverage and popularity of wireless networks such as GPRS and WiFi have been continuously improved, and the application of mobile terminal equipment has also been continuously developed. These favorable conditions greatly improve the mobile network application experience of users who use mobile terminal devices to surf the Internet. Therefore, increasing Internet users begin to use mobile devices and mobile networks to access any network anytime, anywhere to obtain the information they need [8]. The mobile network mode is shown in Figure 1.

As a well-known network technology, traditional network also occupies a large share in the market. The Internet technology used in many homes and offices is the traditional wired network technology. The traditional network generally refers to the applied Ethernet, which is a wired network. It is highly coupled, centrally controlled, and difficult to manage, which is the representative of the traditional wired network. It is shown in Figure 2.

After entering the twenty-first century, the rapid development of information networks is not limited to the well-known traditional wired network, but to a more comprehensive technology. The rapid development of more flexible wireless mobile networks enables users to truly enjoy convenient, efficient, and fast mobile network services [9]. The reason that the mobile network occupies a large position in the current market is closely related to its own advantages. First of all, the mobile network can well solve the insurmountable difficulties such as the long-distance distribution of the traditional network and the inconvenience of network connection and wiring in multiple regions. Secondly, in the construction of campus network, the use of mobile network can realize resource sharing and unified management among multiple campuses. It can also easily and quickly establish virtual classrooms, electronic libraries, and data centers for classrooms and students at any time and anywhere in the school and provide users with convenient and instant Internet access services [10]. And compared with the traditional network, the mobile network also shows unparalleled superiority. For example: mobile network usage costs are lower. It can be moved between APs at will, eliminating the

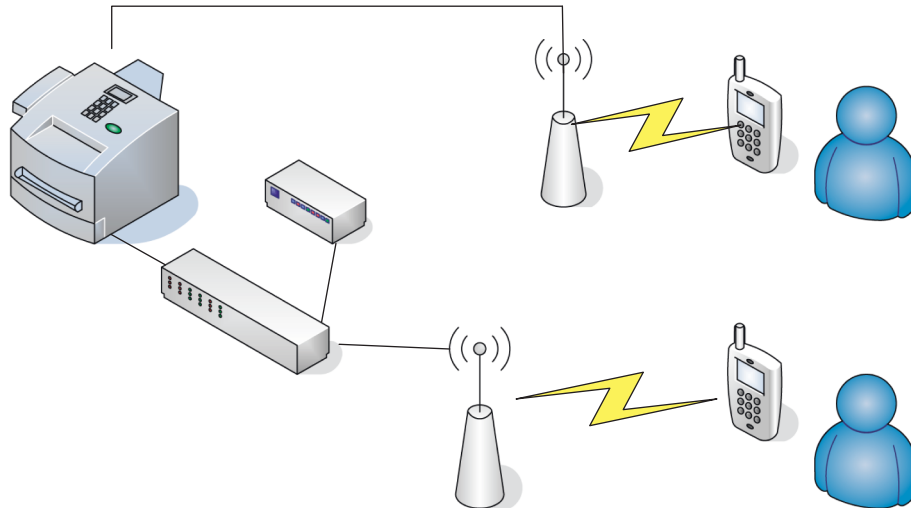


FIGURE 1: Mobile network mode.

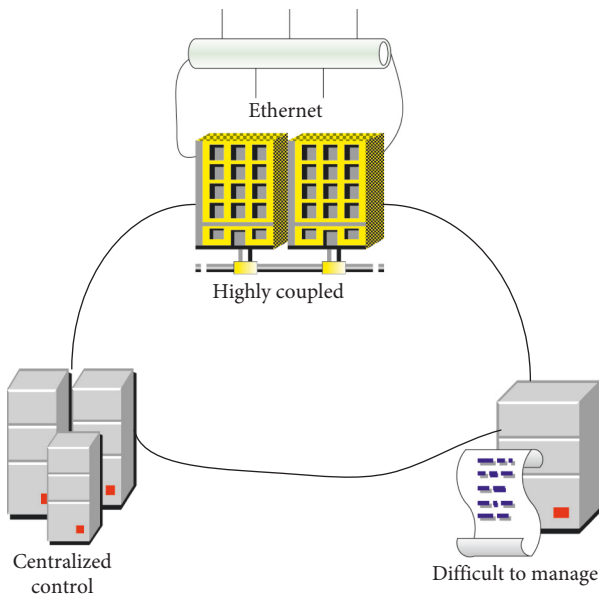


FIGURE 2: Traditional network characteristics.

time and installation costs associated with a lot of traditional network cabling. The use of mobile network is unrestricted, and it can be used with a mobile phone, which can flexibly adjust and update the network configuration. This makes network usage independent of time and place. The use of the mobile network is targeted, and in the process of transmitting information, the information required by the user is transmitted to the user's mobile phone terminal through the mobile network, and the service is more proactive and targeted for the user. It is foreseeable that the mobile network service technology will have a better development prospect in the future [11]. The comparison between mobile network and traditional network can be shown in Table 1.

3.1.2. *Key Technologies.* The key technology of mobile network is cache. With the rapid development of mobile

networks, the caching technology of mobile networks has been upgraded to in-network caching. On the one hand, in-network caching can effectively reduce network latency and improve user experience. On the other hand, it can also reduce the redundant transmission of traffic in the network and the occupation of network resources. In-network caches of current mobile networks mainly include core network caches and base station caches. These two caching technologies are representative differences between mobile networks and traditional network caching technologies and can easily distinguish traditional wired networks and mobile wireless networks to a certain extent. The core cache refers to the cache in the centralized network architecture of the mobile network. The network architecture is mainly composed of network elements such as mobile management equipment, service gateway, and packet data gateway. The core cache reduces the network transmission traffic and the response time of user requests to a certain extent and can efficiently cache the content on the user terminal. The base station cache is the cache in the mobile network base station. Base stations are an important part of mobile networks. Its main function is to improve the network access and service request interface for users and realize network data interaction. The mobile network base station is the closest to the user and can realize direct communication with the user. Therefore, the base station cache can effectively reduce the user's request delay and can also reduce the traffic transmission generated by forwarding user requests and data responses in the mobile network, thereby reducing the network load. Base station caching plays an important role in reducing network operating costs and reducing network congestion.

Although the key technologies of mobile network caching play a significant role in reducing data transmission delay and network traffic load, these technologies still have certain problems and challenges. There are mainly problems in cache resource management, content security, and channel interference. With the popularization of mobile network applications and the continuous increase of users,

TABLE 1: Traditional and mobile networks.

		Traditional network	Mobile network
Functions and features	Mobility	cannot move around	Can move randomly
	Convenience	Wiring required	Solve wiring difficulties
	Economy	High cost	Save costs
	Flexibility	Restricted	Unrestricted
Terminal type		Single PC	Rich and varied

the data traffic generated by the mobile network is increasing. These increasing amounts of traffic data not only require sufficient cache space, but also require extremely high network bandwidth to transmit it to the network edge or cloud for processing. Therefore, how to achieve efficient allocation and management of cache resources has become a difficult problem that must be overcome. For both traditional networks and mobile networks, user privacy and security have always been the most important issue for users. The traditional network has a relatively strict security protection mechanism, and the security is relatively high. However, due to some deficiencies in content encryption in the mobile network in network cache, there are certain challenges to strictly ensure the security of user privacy data cached in the mobile network. Finally, one of the most significant problems with wireless mobile networks compared to traditional wired networks is signal fading caused by interference between signals. This makes the actual application effect of even the optimized caching strategy unsatisfactory. For example, distributed cache cannot reflect wireless resource utilization, the coexistence of multiple interfaces in network access may greatly reduce communication efficiency, and network scalability is limited. All in all, although the caching technology of mobile networks has more advantages over traditional wired networks, there are still some problems to be improved. With the continuous innovation and improvement of mobile network technology, these problems will definitely be improved in the future. This enables the wireless mobile network technology to better provide users with relevant network resource services and improve user experience and satisfaction.

3.2. Mobile Network Data Collection Algorithm. In mobile wireless networks, a large number of low-cost static sensor nodes with wireless communication functions are widely dispersed in the area to be detected. These nodes have the function of collecting the required data at any time, packaging the data, and delivering the data to the user at the appropriate time. This is the data acquisition algorithm function of the mobile network [12]. This algorithm can minimize the energy consumption of each static sensor under the premise of satisfying the data collection efficiency. This means that the required data can be collected with the highest efficiency and the least energy consumption. The basic idea of this algorithm can be shown in Figure 3.

The data collection efficiency of mobile wireless static sensors is p , and the probability of collecting all static sensor data in the whole network within a given time T is defined as [13]

$$P = p \left\{ \cap_{a=1}^{NL} AL \right\}. \quad (1)$$

Among them, AL indicates that the data of sensor i is successfully collected within the time limit T , and P is the probability that all sensors collect complete data.

Next, it is assumed that the energy consumed by each static sensor data transmission time T in the mobile wireless network is e :

$$e = \min \left\{ \frac{E_{LA}}{E_N} \right\}. \quad (2)$$

The following optimization problems are solved in this paper:

$$\begin{aligned} \text{subject to } P &= p \left\{ \cap_{i=1}^{NL} A \right\}, \\ P_{\text{out}} &= \frac{P_a}{C_t} \left(\frac{2\pi}{\gamma} \right) a. \end{aligned} \quad (3)$$

Among them, C_t and γ are the transmit antenna gain and transmit signal wavelength, respectively.

$$P_a = \frac{\tau \aleph}{n} p_{\text{out}}. \quad (4)$$

Among them, \aleph is the peak-to-average ratio of the transmitted signal, and n is the drain efficiency of the RF power amplifier. At this time:

$$\aleph = 4 \frac{\sqrt{N} - 1}{\gamma + 1}. \quad (5)$$

In summary, the sensor communication power consumption in independent mode is

$$P_t^c = \frac{\aleph}{n} \left(\frac{2\pi}{\gamma} \right) N + PA. \quad (6)$$

At this time, the data power consumption in the sensor data transmission duration T is

$$E_{lc} = T \left\{ \frac{\aleph}{\gamma} (L + \gamma)^2 + P \right\}. \quad (7)$$

The steps of static sensor data acquisition in standalone mode are shown in Figure 4.

In the cooperative communication mode, the data consumption energy of each static sensor within the data transmission duration T is

$$E_c = \frac{LT + (3L + 1) + NT_a}{P}. \quad (8)$$

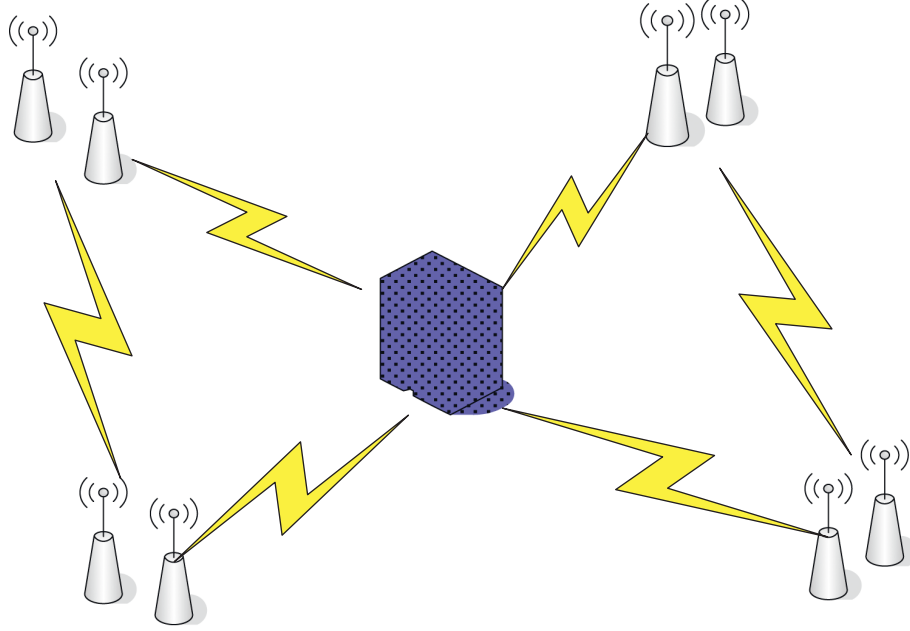


FIGURE 3: Basic idea of mobile network data collection algorithm.

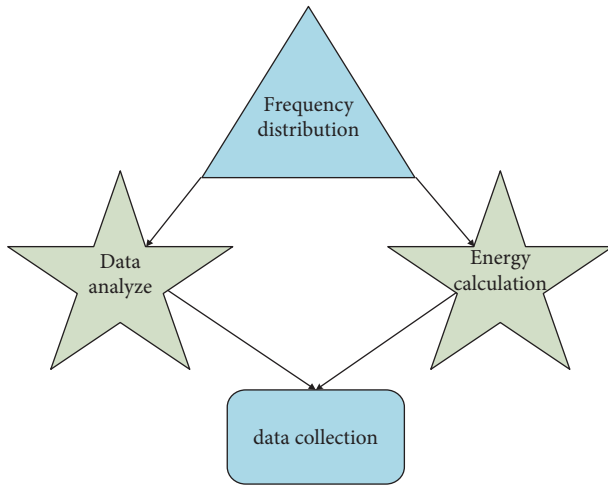


FIGURE 4: Standalone static sensor data acquisition steps.

Among them, LT is the node synchronous communication duration. Next, this paper discusses the optimal communication distance when $N=1$. At a certain moment, the probability of a mobile node falling within the sensor communication area is

$$P = \frac{\theta\pi}{R}L. \quad (9)$$

Therefore, within a given time limit, the probability that all nodes of the sensor are visited at least once is

$$P(N=1) = 1 - \left(\frac{\theta r}{\pi}\right)T_{\max}. \quad (10)$$

The optimal communication distance satisfies the condition of $P(N=1) > C$. Next order:

$$r = \sqrt{\frac{2\theta}{\pi}(1 - T_{\max})\sqrt{1 - C}}. \quad (11)$$

Therefore, when $N=1$, the optimal communication distance under the random walk model is

$$OTP = \frac{4\pi}{\theta}(1 - T_{\max}\sqrt{1 - C}). \quad (12)$$

Therefore, under the random walk model, the probability that $N > 1$ static sensor nodes are all visited at least once within a given time limit is

$$P(A) = 1 - \sum_{a=1}^N C_n \left(1 - n \frac{\theta r}{2\pi}\right)T_{\max}. \quad (13)$$

If $P(A) > C$, the lower limit of the communication distance can be obtained, that is, the optimal data acquisition communication distance [14, 15]. The basic process of the entire data acquisition algorithm can be shown in Figure 5.

Next, this paper will carry out the historical geographic information system construction experiment based on the data collection algorithm of mobile network, to explore whether the mobile network technology is effective for the construction of historical geographic information systems.

4. Construction Experiment of Historical Geographic Information System Based on Mobile Network

4.1. Experimental Method. The main experimental method of this experiment is as follows: it firstly constructs the historical geographic information system by the traditional method, and after the construction is completed, the information utilization rate and information integrity in the constructed information system are tested. The pros and

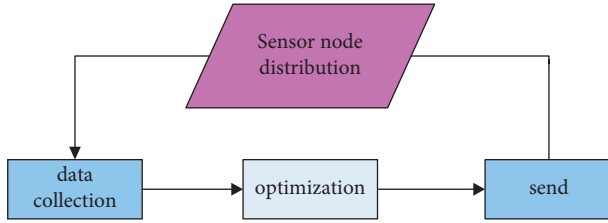


FIGURE 5: Basic process of mobile network data collection algorithm.

cons of constructing an information system are mainly judged according to the completeness of the information. Secondly, the historical geographic information system is constructed by combining the mobile network data collection algorithm. After the construction is completed, the information utilization and completeness of the constructed historical geographic information system are also tested, judging the pros and cons of the historical geographic information system constructed based on the mobile network according to the information integrity [16, 17]. Finally, the information integrity of the historical geographic information system constructed by the traditional method is compared with the information integrity of the historical geographic information system constructed based on the mobile network, and the experimental conclusion is drawn [18].

4.2. Construction of Historical Geographic Information System Based on Traditional Methods. Before constructing the historical geographic information system, this paper needs to determine several important historical geographic information system construction dimensions. It also builds an information system from these dimensions, making the built information system more reliable. It is shown in Table 2.

As can be seen from Table 2, the three main dimensions of the historical geographic information system construction are attribute, time, and space. In this paper, these three dimensions are labeled 1, 2, and 3, respectively. The proportion of information of these three dimensions in the historical geographic information system is shown in Figure 6.

As can be seen from Figure 6, the proportion of these three dimensions in the construction of the entire historical geographic information system is relatively balanced, accounting for about 35%, respectively. Next, this paper will proceed from these three main dimensions to construct the traditional historical geographic information systems. After the construction is completed, the utilization and integrity of the information in the system are tested. The information utilization test results are shown in Figure 7.

The information integrity test results are shown in Figure 8.

Combining Figures 7 and 8, it can be calculated that the average utilization rate of three-dimensional comprehensive information of the traditionally constructed historical geographic information system is 60%, and the average information integrity is 80%. This shows that although the

TABLE 2: Dimensions of historical geographic information system construction.

	History	Geography
Attribute data	2	2
Time data	3	4
Spatial data	2	3

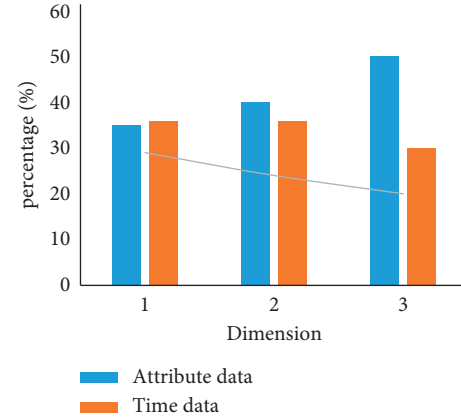


FIGURE 6: The proportion of three dimensions of information.

information utilization and information integrity of the historical geographic information system constructed based on traditional methods are at the upper-middle level, they have not reached an ideal level [19].

4.3. Construction of Historical Geographic Information System Based on Mobile Network. Next, this paper will combine the mobile network data collection algorithm to construct a new round of historical geographic information systems. In this construction, this paper first runs the mobile network data collection algorithm to collect historical geographic related data based on three main dimensions. In this way, the construction time of the historical geographic information system can be saved to the greatest extent, thereby improving the efficiency of data collection. After the construction, this paper also tests the information utilization and information integrity of the constructed historical geographic information systems. The test results are shown in Figure 9.

It can be calculated from Figure 9 that the comprehensive dimensional information utilization rate of the historical geographic information system constructed based on the mobile network is 70%, and the information integrity is 98.2%. It calculates the completeness of information in two historical geographic information systems constructed based on different methods. The next step is the last step of this experiment: this paper compares the information integrity of the historical geographic information system constructed based on the traditional method with the information integrity of the historical geographic information system constructed based on the mobile network technology [20]. It is shown in Figure 10.

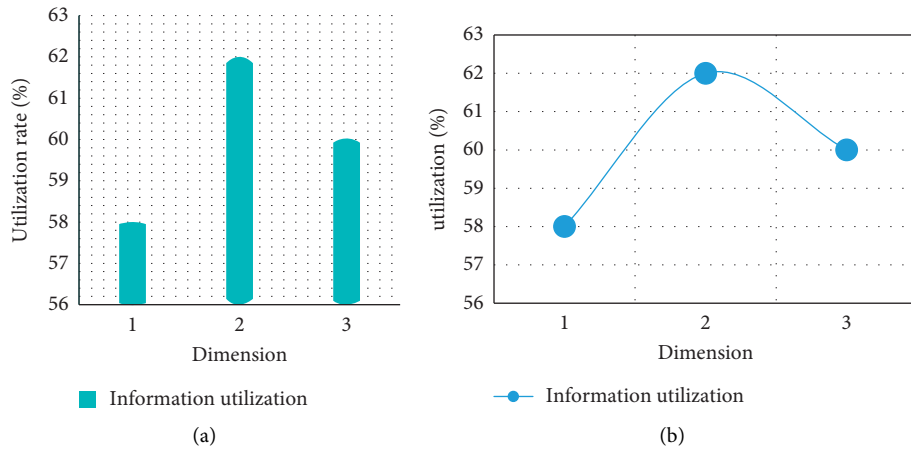


FIGURE 7: Information utilization of traditional historical information system. (a) Utilization statistics. (b) Utilization curve.

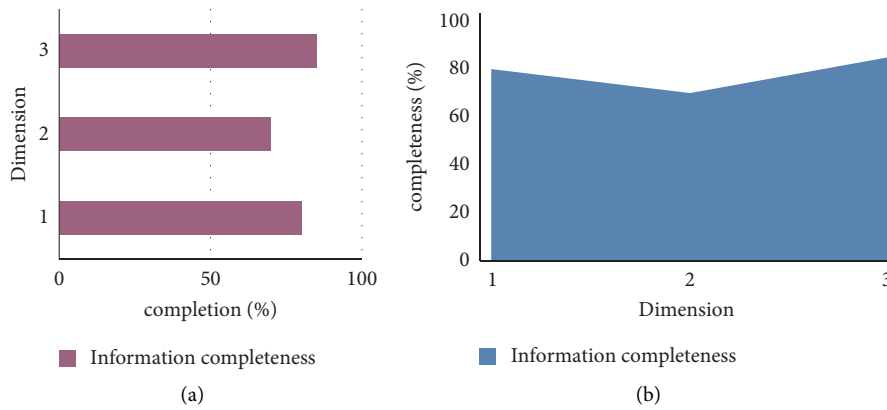


FIGURE 8: Information integrity of traditional historical geographic information system. (a) Integrity statistics. (b) Integrity ratio.

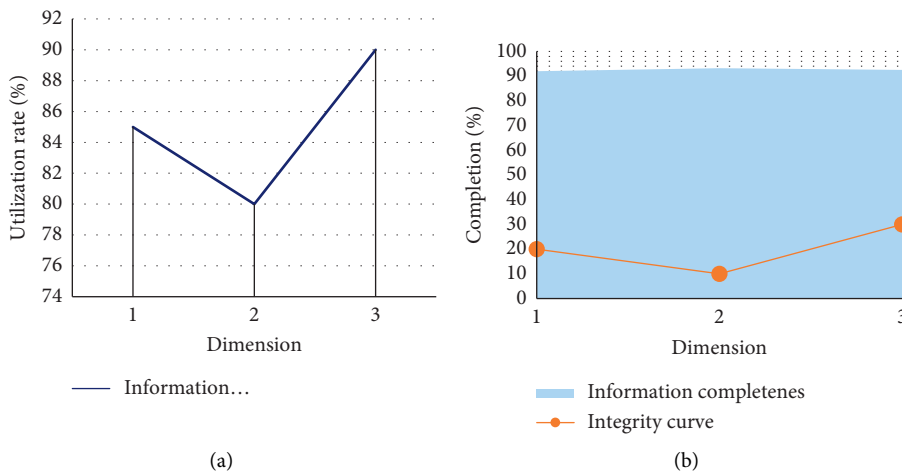


FIGURE 9: Information utilization and completeness of historical geographic information system based on mobile network. (a) Information utilization. (b) Information integrity.

Combined with the comparison results in Figure 10, it can be easily calculated that the information integrity of the historical geographic information system constructed based on mobile network technology is 18.2% higher than that of the traditional historical geographic information systems.

This shows that the historical geographic information system constructed based on mobile network technology has high information integrity. A higher degree of information integrity means that the constructed information system is more complete, which means that the construction method

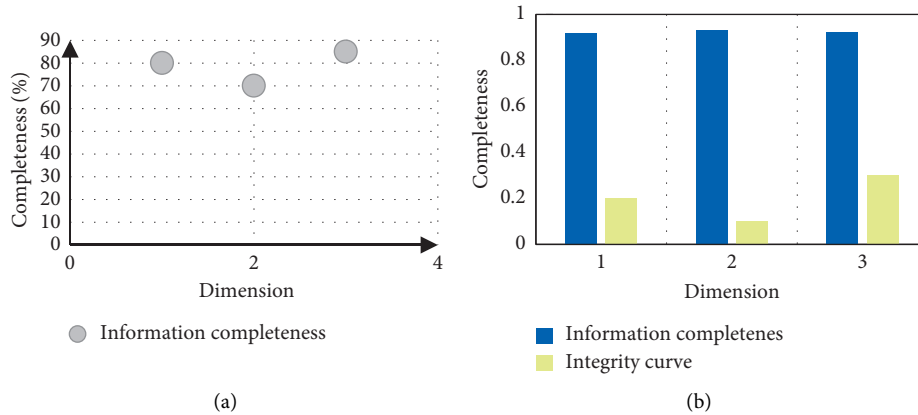


FIGURE 10: Comparison of historical GIS information integrity based on traditional methods and mobile network technology. (a) Information integrity of traditional historical geographic information system. (b) Information integrity of mobile network historical geographic information system.

has a significant helping effect on the construction of the system. Therefore, this paper can draw the conclusion that mobile network technology has a certain help for the construction of historical geographic information systems.

5. Discussion

As an important part of academic research, historical geography research occupies an important position in the academic research community. The development of historical geographic research is closely related to the continuous improvement of the historical geographic information systems. For the construction of a historical geographic information system, scientific and effective technical support is tantamount to a run-up tool, which can promote its continuous improvement. With the continuous innovation and development of science and technology, there are increasingly advanced technologies and methods that can contribute to the construction of historical geographic information systems, such as mobile network technology.

Mobile network refers to a technology that uses a variety of available mobile devices to connect to public networks to enable Internet access and services [21]. Compared with the traditional network, the biggest technical advantage of the mobile network is that it is free from the restriction that a fixed terminal device can be used to access the Internet. It realizes that any terminal device can be connected to the Internet for access. This advantage of the mobile network makes the mobile network increasingly widely used in the market at present, occupying a higher and higher market share. Moreover, the cost of using the mobile network is low, and the difficulty of a large number of wirings that the traditional network will face is eliminated. Users are more flexible when using mobile networks, are not limited by time and space, and are more targeted for network resource acquisition. Therefore, the application scope of mobile networks in various fields is constantly expanding. It can also be foreseen that the mobile network service technology will have better development prospects in the future.

This paper discusses the construction method of the historical geographic information system combined with the mobile network data collection algorithm and designs a historical geographic information system construction experiment based on the mobile network data collection algorithm. In the experiment, the historical geographic information system construction experiment is carried out by using the traditional historical geographic information system construction method and the historical geographic information system construction method based on the mobile network data acquisition algorithm. It compares the completeness of information in the two historical geographic information systems constructed and draws experimental conclusions. The information integrity of the historical geographic information system constructed based on the mobile network data collection algorithm is 18.2% higher than that of the traditional historical geographic information systems. This shows that mobile network technology has a certain improvement effect on the construction of historical geographic information system [22]. On the whole, this experiment was relatively smooth, and no major problems were encountered in each experimental step, and finally an effective conclusion was drawn. However, there is still room for innovation in this experiment in terms of experimental methods. Overall, there is still room for improvement in the experiment.

6. Conclusions

Historical geography research is an important sector in the academic research community and has certain research significance. The construction of a historical geographic information system is one of the important steps in historical geographic research. Historical geography research is closely related to the construction of a historical geographic information system. However, the traditional historical geographic information system construction methods that have been used all time have some limitations in various aspects. These limitations can easily hinder the progress of historical geography research. Therefore, more effective construction

methods of historical geographic information systems are needed to continuously improve the construction of a historical geographic information system, thereby promoting the progress of historical geographic information research. With the continuous improvement of the level of science and technology in contemporary society, the construction method of historical geographic information system is also constantly innovating. Among them, the most prominent is the mobile network technology, and the mobile network refers to an advanced network service technology. It enables Internet access and services by connecting to public networks using a wide variety of mobile devices. In this paper, according to the research theme of the construction method of historical geographic information system based on mobile network, an experiment of building a historical geographic information system combined with mobile network data collection algorithm is designed. The research conclusions drawn in this paper have a certain reference value for the application of mobile network technology in the construction of a historical geographic information system. It also plays a positive role in improving the construction of a historical geographic information systems and promoting historical geographic research. However, due to the limited research level and conditions, the research of this paper also has some limitations; for example, the research angle and method are still insufficient and not comprehensive enough. It is believed that there will be more and better studies on the construction and improvement of the historical geographic information system in the academic circles in the future, to continuously promote the development of historical geographic research.

Data Availability

Data sharing is not applicable to this article as no datasets were generated or analysed during the current study.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

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