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Data Information Protection Quality Management of the Characteristic Tourism Virtual Experience System in Changbai Mountain

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Abstract

In order to improve the privacy protection ability of the data information of the characteristic tourism virtual experience system in Changbai Mountain, the data information protection quality management model of the characteristic tourism virtual experience system based on the linear encryption and the statistics mapping is put forward. The large data distribution structure model of the data information of the characteristic tourism virtual experience system of the Changbai mountain is constructed. The fuzzy correlation feature quantity of the data information of the characteristic tourism virtual experience system of the Changbai Mountain is extracted. Lastly, the extracted Changbai Mountain characteristic tourism virtual experience system data information correlation feature quantity is encoded and rearranged by adopting a line space reconstruction method. By adopting the non-linear vector quantization coding method, the homomorphic fusion encryption of the data information of the characteristic tourism virtual experience system in Changbai Mountain is carried out, the random linear encryption key and the decryption key are designed, and the encryption transmission and the information protection of the data information of the characteristic tourism virtual experience system of the Changbai Mountain are realized. The simulation ends in various results: the data information protection quality management performance of the characteristic tourism virtual experience system of Changbai Mountain is good, the data information protection quality management capability is strong, the anti-attack capability is good, and the characteristic tourism virtual data encryption and protection control capability of the Changbai Mountain is good.

Keywords: Changbai Mountain; characteristic tourism; virtual experience; system; data information; protection; quality management

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1 Introduction

With the continuous improvement of the national economic income, the construction of tourist attractions has garnered more and more attention from cultural departments, especially in cities rich in tourism resources. Efforts should be made to build local tourist attractions into national and even internationally famous brands. For tourists, the choice of a tourist destination mainly depends on the popularity of scenic spots and the level of landscape design. In recent years, the government has increased the infrastructure construction of Changbai Mountain characteristic tourism, but compared with other historical towns [1], the overall level of the Changbai Mountain characteristic tourism infrastructure construction is still low. In addition, the Changbai Mountain characteristic tourism internal tourism reception capacity is weak. Tourism catering and accommodation reception is mainly based on "Nongjiale" in Hantun, and the drainage facilities in the small town are not complete. Furthermore, the road water in the rainy season cannot be discharged effectively and quickly. The above reasons make the Manchu town in Wula Street not have very efficient tourism reception capacity, and make it so that it cannot adapt to the surge of local tourists year by year. In addition, the related tourism reception enterprises' lack of specialization, standardized training is also an issue that needs paying attention to. To sum it up, the related facilities of Changbai Mountain characteristic tourism and the local tourism service quality are still at a low level, which leads to the low service efficiency and the decline of tourists' experience, which cannot form a strong attraction to the tourists who come to the small town [2].

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The characteristic tourism virtual experience system of Changbai Mountain is built, the characteristic tourism virtual experience value of the Changbai Mountain is improved, the data information of the characteristic tourism virtual experience system of the Changbai Mountain is encrypted and stored, and the risk that the data information of the characteristic tourism virtual experience system of the Changbai Mountain is leaked is reduced. The research of the data information encryption method of the characteristic tourism virtual experience system in Changbai Mountain is of great significance in promoting the information construction of the data. The research on the data information encryption method of the characteristic tourism virtual experience system of Changbai Mountain is greatly concerned by people [3-5]. The encryption of the data information of the characteristic tourism virtual experience system of Changbai Mountain is based on the linear coding of the data, and the coding combination control model of the data information of the characteristic tourism virtual experience system of the Changbai Mountain is constructed. By adopting a symbol sequence recombination method to carry out the encryption design of the data information of the characteristic tourism virtual experience system of the Changbai Mountain, the correlation characteristic quantity of the data information of the characteristic tourism virtual experience system of the Changbai Mountain is extracted, the arithmetic coding and the key optimization design method are adopted, and the optimized encryption of the data information of the characteristic tourism virtual experience system of the Changbai mountain is determined [6].

2. Introduction to the Natural and Human Environment of Changbai Mountain

2.1. Introduction to the Natural Environment

The Changbai Mountain Range is the highest mountain on the eastern edge of Eurasia. It is located in the southeast of the Jilin Province and is adjacent to the border between China and North Korea. Changbai Mountain in the narrow sense refers to the main peaks and main veins of the Changbai Mountains, that is, the Changbai Mountains including the main peak of the Changbai Mountain. Changbai Mountain in the broad sense refers to the mountainous areas in the eastern mountains of China's Liaoning, Jilin, and Heilongjiang provinces, as well as the Russian Far East and the many remaining veins of the Korean Peninsula.

The main peak of the Changbai Mountains is located in the southeast of the Jilin Province. It is the birthplace of the Yalu River, Songhua River, and Tumen River. It is also the birthplace of the Manchu and the sacred mountain of Manchu culture. The highest peak of the Changbai Mountains in China is Baiyun Peak with an altitude of 2691 meters, which is also the highest peak in Northeast China.

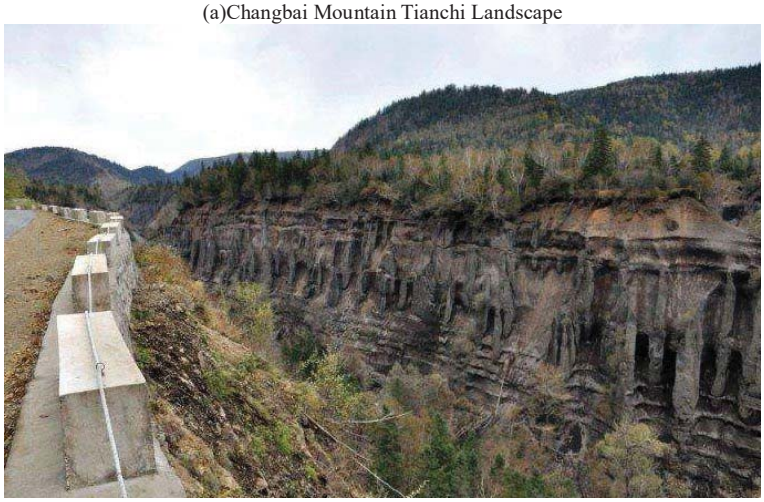
The vertical vegetation landscape and volcanic landscape of the Changbai Mountain are the first national natural heritage sites to enter the "China National Natural Heritage, National Natural and Cultural Heritage Preparatory List". In 2010, it was successively identified as the first batch of national-level nature reserves, the first batch of national 5A-level tourist attractions, the United Nations "Man and Biosphere" nature reserve, and international A-level nature reserves. Changbai Mountain and its Tianchi, waterfalls, snow sculptures, forests and seas, etc., have been selected as the most recorded in the "Guinness" world. Changbai Mountain has outstanding universal value, excellent natural quality, and rich cultural connotation in many aspects such as ecology, biology, geology and history.

Changbai Mountain is a dormant volcano. It is a giant complex volcano. The outer lava plateau is slightly irregular, with a long axis of about 140 kilometers and a northeast extension, and a short axis of about 120 kilometers. From the end of the Pliocene to the beginning of the Pleistocene, three large basalt spills stacked to form plateaus and mountains.

2.2. Introduction of Tourism Resources

The main tourism resources of Changbai Mountain are magical and spectacular volcanic landscapes and landscapes: typical and complete mountain forest ecosystems. a wide variety of animal and plant resources of all kinds, unique and strange ice and snow scenery in the Northland, widely distributed volcanic springs, waterfalls and Rivers and lakes, humanistic landscapes, historical sites, and folk customs with solitary characteristics.

(a)Changbai Mountain Tianchi Landscape



(b)Yalu River Grand Canyon Landscape

Figure 1. landscape of Changbai Mountain

Changbai Mountain has a good combination of resources. In addition, the combination of the advantages and disadvantages of tourism resources and environmental protection is clear, which is conducive to the development of tourism and ecological environmental protection. The scenery of Changbai Mountain has its own characteristics throughout the year. The flowing hot spring is like a gentle piece of music to accompany tourists in the spring, summer, autumn and winter. The landscape of the famous Changbai Mountain Tianchi and the Yalu River Grand Canyon is shown in Figure 1.

3. Changbai Mountain Characteristic Tourism Encryption Theory and Coding Design

3.1. Combination Coding of the Data Information of the Characteristic Tourism Virtual Experience System of Changbai Mountain

In order to realize that super-hybrid encryption of the data information of the characteristic tourism virtual experience system of Changbai mountain, a large data distribution structure model of the data information of the characteristic tourism virtual experience system of the Changbai mountain is first constructed. The structure of the data information of the characteristic tourism virtual experience system of the Changbai Mountain is carried out by using the information super-mixing sequence, and the fuzzy correlation characteristic quantity of the data information of the characteristic tourism virtual experience system of the Changbai Mountain is extracted. Then, the combined cyclic shift encryption control technology is combined. The key design of the data information of the characteristic tourism virtual experience system of the Changbai Mountain is carried out, and the ciphertext construction is carried out according to the initial distribution characteristic of the key [7].

In the public key encryption mode, the data information of the Changbai Mountain characteristic tourism virtual experience system is reorganized by a hyperchaotic key, and the homomorphism distribution structure model of the data information encryption of the Changbai Mountain characteristic tourism virtual experience system is constructed by using a random linear encryption method. In the hyperchaotic encryption system, the extended public key encryption method is used to control the ciphertext in the encryption process [8]. The statistical encryption key protocol for data information encryption of Changbai Mountain characteristic tourism virtual experience system is described as follows:

$$|\phi\rangle_{121} = |0\rangle_1 |0\rangle_2 \tag{1}$$

$$|\phi\rangle_{122} = |1\rangle_1 |1\rangle_2 \tag{2}$$

The public key structure model of automatic encryption of data information of Changbai Mountain characteristic tourism virtual experience system is established [9]. Under the mixed encryption mode, the arithmetic code of data information encryption of Changbai Mountain characteristic tourism virtual experience system is as follows:

$$\begin{aligned} |\psi^+\rangle &= \frac{1}{\sqrt{2}}(|0\rangle_1 |1\rangle_2 + |1\rangle_1 |0\rangle_2) \\ |\psi^-\rangle &= \frac{1}{\sqrt{2}}(|0\rangle_1 |1\rangle_2 - |1\rangle_1 |0\rangle_2) \\ |\Phi^+\rangle &= \frac{1}{\sqrt{2}}(|0\rangle_1 |0\rangle_2 + |1\rangle_1 |1\rangle_2) \\ |\Phi^-\rangle &= \frac{1}{\sqrt{2}}(|0\rangle_1 |0\rangle_2 - |1\rangle_1 |1\rangle_2) \end{aligned} \tag{3}$$

A hyperchaotic analytic cipher is constructed by using Rossle chaotic mapping. Based on the approximate maximum common factor block encryption method, the expression of the Logistic hyperchaotic map under a hyperchaotic mixed encryption protocol is obtained as follows:

$$f(x) = \begin{cases} x / P_1 & x \in I_1 \\ (x - P_1) / P_2 & x \in I_2 \\ ..... & \\ (x - \sum_{i=1}^{n-1} P_i) / P_n & x \in I_n \end{cases} \tag{4}$$

A proxy re-encryption design is carried out on the data information of the characteristic tourism virtual experience system of the Changbai mountain between the authorized persons. The encryption key matrix and the $\boldsymbol{b} = (b_{i,j}^{'})_{1 \le i,j \le \mu} \in (-2^{\alpha'}, 2^{\alpha'})^{\mu \times \mu}$ of the verifier are designated, and the bilinear mapping of the data information mixed encryption of the characteristic tourism virtual experience system of the Changbai Mountain is met as:

$$\sum_{i=1}^{n} P = 1_i \tag{5}$$

$$I_1 = [0, P_1] \tag{6}$$

$$I_i = [\sum_{j=1}^{i-1} P_j, \sum_{j=1}^{i} P_j], i = 2, 3.....n \tag{7}$$

According to the theory of source entropy, the data information of Changbai Mountain characteristic tourism virtual experience system is reorganized by using the Logistic hyperchaotic sequence, and the fuzzy correlation characteristic quantity of data information of the Changbai Mountain characteristic tourism virtual experience system is extracted. The automatic encryption and optimal control of data information of Changbai Mountain characteristic tourism virtual experience system are realized.

3.2. Structural Reorganization and Coding of Data Information in Changbai Mountain Characteristic Tourism Virtual Experience System

On the basis of the structure recombination of the data information of the characteristic tourism virtual experience system of the Changbai Mountain, the characteristic quantity of the fuzzy correlation of the data information of the characteristic tourism virtual

experience system of the Changbai Mountain is extracted. The threshold function of the design of the heavy encryption key is $V=\frac{1}{2}\sigma^T\sigma$ .Generating a search threshold through a private key and obtaining the ciphertext sequence output of the data information of the characteristic tourism virtual experience system data information of the Changbai Mountain to be encrypted by the special tourism virtual experience system is as follows:

$$\begin{aligned}\dot{V}=\sigma^T\dot{\sigma}=\sigma^T C_n\{f(X,t)-x_{1d}^n-p(t)^{(n)}+C_n^{-1}\sum_{k=1}^{n-1}C_k[e^{(k)}-p(t)^{(k)}]\}+\\ \sigma^T C_n b(X,t)u+\sigma^T C_n[\Delta f(X,t)+d(t)]\\ \le\sigma^T C_n\{f(X,t)-x_{1d}^n-p(t)^{(n)}+C_n^{-1}\sum_{k=1}^{n-1}C_k[e^{(k)}-p(t)^{(k)}]\}+\\ \sigma^T C_n b(X,t)u+\left\|\sigma^T C_n\right\|\cdot\left\|\Delta f(X,t)+d(t)\right\|\end{aligned} \tag{8}$$

The encrypted ciphertext is uploaded to the data statistical terminal of the characteristic tourism virtual experience system data information of the mobile Changbai mountain, and the plaintext sequence of the data information of the characteristic tourism virtual experience system of the Changbai mountain is output. Furthermore, the key cipher text parameter k is constructed, and under the arithmetic coding system, the following expression coding formula for obtaining the keyword ciphertext back to the user is as follows:

$$f^{-1}(I)=\begin{cases}p*I, & s=0\\ 1-(1-p)*I, & s=1\end{cases} \tag{9}$$

i represents the correlation between the master key msk and the identity information of the user, and the initial distribution interval satisfies the $I=[0,1]$. The ciphertext generated by the data information keyword of Changbai Mountain characteristic Tourism Virtual experience system is $param=\{G_1,G_2,e,g,g_2,g_3,h,H_1,H_2\}$, in which $m_{i,j}\leftarrow\left[c^*\right]_{p_{i,j}}$.

Combined with the re-encryption key query method, the segmented Logistics sequence of the data information of the Changbai Mountain characteristic tourism virtual experience system is arranged. Under the control of the re-encryption key protocol [10], the private subkey of the complete *sk* is obtained as follows:

$$\begin{aligned}&(rk_{1ij},rk_{2ij},rk_{3ij},rk_{4ij},rk_{5ij},rk_{6ij})=\\ &(g^{x_ik_i},(g^{t_0}h)^{x_ik_i},\frac{x_j}{x_i},sr_i^{x_i^{-1}(t_0-t_i)}sr_j^{x_i^{-1}(t_j-t_0)},k,g^{k_i})\end{aligned} \tag{10}$$

wherein:

$$k=e(g^{k_i},g_i^{u_i(t_0-t_i)}g_i^{u_j(t_j-t_0)})\frac{e(g^{k_i},sk_{i1}g_1^{l_i})}{e((g^{t_0}h)^{k_i},g^{u_i})}e(g,g_1)^{-k_il_i} \tag{11}$$

The chaotic automatic encryption design is carried out by using a hyperchaotic sequence recombination method, and the data information structure reorganization and arithmetic coding model of the Changbai Mountain characteristic tourism virtual experience system are constructed. In addition, the automatic encryption ability of data information of Changbai Mountain characteristic tourism virtual experience system is improved [11].

4. Automatic Encryption Optimization of Data Information Protection in Changbai Mountain Characteristic Tourism Virtual Experience System

4.1. Key Construction of Encryption of Data Information in Changbai Mountain Characteristic Tourism Virtual Experience System

On the basis of using the Logistic hyperchaotic sequence to reconstruct the data information of the Changbai Mountain characteristic tourism virtual experience system, the encryption and optimization design of the data information of Changbai Mountain characteristic tourism virtual experience system is carried out. A data information protection quality management model of Changbai Mountain characteristic tourism virtual experience system based on linear encryption and Logistics mapping is proposed. Based on the user key leakage control scheme [12], the super-hybrid key design is carried out, the arithmetic coding rule

of the other sub-keys is obtained, the related rule item is $S^{n-1}=\{x\in R^n:\|x\|=1\}$, and the grouping key in the data information transmission link layer block of the characteristic tourism virtual experience system of the mobile Changbai Mountain is defined:

- Decrypt (*sk*, *c*): Outputs the encrypted super hybrid arithmetic coding cipher text $\mathbf{m}=(m_0,\ldots,m_{i-1})$ of the data information of the characteristic tourism virtual experience system of the Changbai Mountain, wherein the $m_j\leftarrow[c]_{p_j} \bmod 2$.
- $\|v\|=\langle v,v\rangle^{1/2}$ is the mobile Changbai Mountain characteristic tourism virtual experience system data information encryption output association rule feature quantity and statistical mutual information function;
- $H_i(u)=\{x\in R^n:\langle x,u\rangle=i\}$ is a security association rule feature distribution set of the user key, wherein the $i\in Z^+, u\in S^{n-1}$;
- By adopting the method of the sequence flow characteristic rearrangement of the coding bit sequence, the fuzzy coding vector $v_1^*, v_2^*, \cdots, v_m^*$ of the data information of the characteristic tourism virtual experience system of the Changbai Mountain is constructed, and the definition is as follows:

$$\mu_{i,j}=\frac{\langle v_i,v_j^*\rangle}{\langle v_j^*,v_j^*\rangle},\quad v_i^*=v_i-\sum_{j=1}^{i-1}\mu_{i,j}v_j^* \qquad v_1^*=v_1 \tag{12}$$

Wherein, $i=1,\cdots,m$, Under very low sampling frequency, the output of the encrypted data carries on the two-dimensional coding of the data information of the mobile Changbai Mountain characteristic tourism virtual experience system [13].

4.2. Hyperchaotic Encryption Transmission and Output of Data Information in Changbai Mountain Characteristic Tourism Virtual Experience System

The nonlinear vector quantification coding method is used to encrypt the data information of the Changbai Mountain characteristic tourism virtual experience system. The random linear encryption key and decryption key are designed [14]. The continuous difference function of hyperchaotic mixed encryption is rearranged in two dimensions. The number of symbols distributed by chaotic encryption is to make $X=x_1,x_2,...,x_n$ in the fuzzy clustering center, and a new bit sequence S of hyperchaotic encrypted privacy protection data is constructed. The average mutual information of hyperchaotic encryption is $-\log_2(P(s_i))$. Changbai Mountain characteristic tourism virtual experience system data encryption random distribution sequence $-\log_2(P(s_i))$ corresponding to the hyperchaotic sequence average information is:

$$H=-\sum_{i=1}^{n}P_i\log_2(P_i) \tag{13}$$

By adopting the piecewise linear mapping method, the ciphertext sequence $s=\{s_i,i=1.....M\,|s_i\in S\}$ of the data information encryption of the characteristic tourism virtual experience system of the Changbai Mountain is constructed, and the super-hybrid automatic encryption design is carried out with the S level as an independent variable. The encrypted ciphertext is as follows:

$$P_n=\frac{1}{M}card\{s_i\,|s_i=S_n\} \tag{14}$$

In the buffer $r_{i,j}\leftarrow\mathbb{Z}\cap\left(-2^{\varphi'-1},2^{\varphi'-1}\right)$ stored in the encrypted bit sequence, there is a steganography feature map $\mathbf{m}=(m_0,\ldots,m_{l-1})$ with mixed encryption of data and information in the mobile Changbai Mountain characteristic travel virtual experience system. At this time, the hyperchaotic automatic encryption of the bit block key distribution satisfies:

$$I^i=f^{-1}(x)(I^{i+1}) \tag{15}$$

$$SIZE(I^i)=P_iSIZE(I^{i+1}) \tag{16}$$

The homomorphic fusion encryption of the data information of the characteristic tourism virtual experience system of Changbai

Mountain is carried out by adopting a non-linear vector quantization coding method, and a random linear encryption key and a decryption key are designed:

RkeyGen (*param*, rsk_{ID_i} , ID_i, ID_j)

$$V = \begin{pmatrix} v_{n-k} & v_{n-k-1} & \cdots & v_1 & v_0 & 0 & 0 & \cdots & 0 \\ 0 & v_{n-k} & \cdots & v_2 & v_1 & v_0 & 0 & \cdots & 0 \\ \vdots & \vdots & \vdots & \vdots & \vdots & \vdots & \vdots & \vdots & \vdots \\ 0 & \cdots & 0 & v_{n-k} & v_{n-k-1} & \cdots & \cdots & v_1 & v_0 \end{pmatrix} \tag{17}$$

The check matrix of ciphertext is:

$$U = \begin{pmatrix} u_0 & u_1 & \cdots & u_{k-1} & u_k & 0 & 0 & \cdots & 0 \\ 0 & u_0 & \cdots & u_{k-2} & u_{k-1} & u_k & 0 & \cdots & 0 \\ \vdots & \vdots & \vdots & \vdots & \vdots & \vdots & \vdots & \vdots & \vdots \\ 0 & \cdots & 0 & u_0 & u_1 & \cdots & \cdots & u_{k-1} & u_k \end{pmatrix} \tag{18}$$

On the basis of a comprehensive analysis, the data information automatic encryption design of the characteristic tourism virtual experience system of Changbai Mountain is realized, and the encryption and transmission capability of the data information is improved [15].

5. Simulation Experiment and Result Analysis

In order to verify the performance of this method in realizing the data information encryption of the Changbai Mountain characteristic tourism virtual experience system, the simulation experiment is carried out.

5.1. Experimental Environment Setup

The experimental platform is based on Xilinx Virtex-5. Combined with Visual C++ and Matlab, the data information encryption of Changbai Mountain characteristic tourism virtual experience system is simulated and analyzed. The sample length of the Changbai Mountain characteristic tourism virtual experience system data information collection is 120 bits, and the number of samples is 1024. The interface of the characteristic tourism virtual experience system of Changbai Mountain is shown in Figure 2.

5.2. Experimental Results and Analysis

The data information packet encryption length of Changbai Mountain characteristic tourism virtual experience system is 400, and the entropy value of large data stream is $X = \left(0, \frac{1}{M}, \frac{2}{M}, \ldots, 1\right)$. The fuzzy correlation feature quantity of data information of the Changbai Mountain characteristic tourism virtual experience system is extracted, and the data information association feature quantity of Changbai Mountain characteristic tourism virtual experience system is encoded and rearranged by line space reconstruction method. The hyperchaotic encryption of data information is obtained, and the hyperchaotic encryption results are shown in Figure 3.

It can be seen from the analysis of Figure. 3 that this method can effectively implement data encryption of Changbai Mountain's characteristic tourism virtual experience system. The encryption effect is better, and the data's anti-attack ability is effectively improved.

Figure 2. Interface of characteristic Tourism Virtual experience system in Changbai Mountain

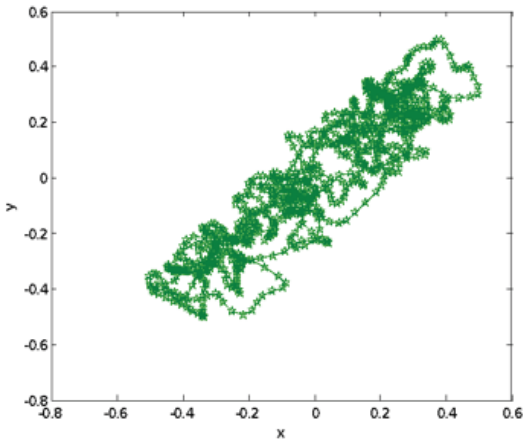


Figure 3. Virtual encryption result of the characteristic tourism in Changbai mountain

On this basis, in order to further verify the effectiveness of the quality management model for data information protection of the characteristic tourism virtual experience system based on linear encryption and statistical mapping designed in this study, the idea of comparative experiments was introduced to test the resistance of different methods of data encryption. The comparison results are shown in Table 1.

In order to clearly display the results shown in Table 1, the call of Table 1 is presented in the form of a histogram, as shown in Figure. 4.

By comprehensively analyzing the results shown in Table 1 and Figure 4, it can be known that applying the method proposed in this article to the data information encryption process of the Changbai Mountain characteristic tourism virtual experience system can greatly enhance the data anti-attack ability and data privacy protection ability.

Table 1. Comparison of Anti-attack performance of encryption

Iterations	Proposed method	Hash	Hyperbolic encryption
100	0.922	0.835	0.845
200	0.976	0.868	0.832
300	0.978	0.912	0.836
400	0.979	0.945	0.947
500	0.980	0.946	0.921

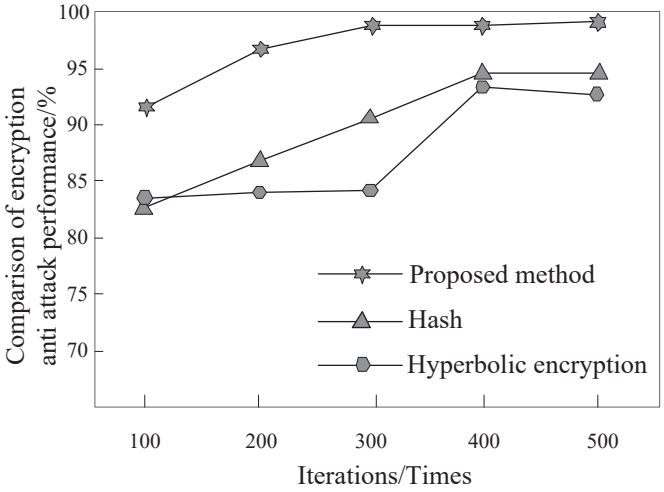


Figure 4. Comparison of experimental results

6. Conclusion

The data information of the Changbai Mountain characteristic tourism virtual experience system is encrypted and stored to reduce the risk of leakage of data information. This paper proposes a data information protection quality management model of the Changbai Mountain characteristic tourism virtual experience system based on linear encryption and Logistics mapping. The fuzzy correlation characteristic quantity of data information of the Changbai Mountain characteristic tourism virtual experience system is extracted, and the key design of data information is carried out combined with cyclic shift encryption control technology. The data information structure of the Changbai Mountain characteristic tourism virtual experience system is reorganized by a Logistic hyperchaotic sequence, and the chaotic automatic encryption design is carried out by a hyperchaotic sequence recombination method. The data information structure reorganization and arithmetic coding model of the Changbai Mountain characteristic tourism virtual experience system are constructed, and the random linear encryption key and decryption key are designed to determine the encryption transmission and information protection of the data information of Changbai Mountain characteristic tourism virtual experience system. It is found that the method has good anti-attack ability in encrypting the data information of the Changbai Mountain characteristic tourism virtual experience system.

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