

Research on Gene Decoding and Living Inheritance of Hebei Revolutionary Cultural Relics Empowered by Digital Intelligence

Sun Yuan Institute for Design, Hebei Academy of Fine Arts

ABSTRACT

Revolutionary relics serve as important carriers for disseminating red culture and bear witness to the hard-won establishment of New China. This study explores and discusses the inheritance and innovation of Hebei revolutionary cultural relics from the perspective of semiotics in the era of digital intelligence empowerment, focusing on the development path of contemporary digital art communication media. By decoding the historical origins and developmental context of Hebei revolutionary cultural relics, the study employs cultural gene theory to decode their forms, colors, and spirit, constructing a digital design research framework for visual symbolization. The gene decoding theory is integrated into the design practice of cultural and creative products, enabling the living inheritance of revolutionary culture through the transmission of these products, which embody the principle of "seeing people, objects, and life." This research provides valuable insights and practical pathways for the development of the cultural and creative industry, significantly contributing to the promotion of Hebei revolutionary culture and contemporary design.

Keywords: Digital empowerment, Red revolutionary relics, Gene decoding, Living inheritance

Revolutionary relics are historical witnesses to the heroic struggles of the Communist Party and important carriers for inheriting the red gene and promoting patriotic spirit. However, over time, many revolutionary relics face issues such as inadequate protection and severe loss. With the application of digital art in the design field, technologies like computer-generated art, digital image processing, and AI have matured, providing technical support for the protection and inheritance of revolutionary relics. The Ministry of Culture and Tourism has repeatedly emphasized the need to "revitalize" excellent cultural resources through digital technology, integrating their inherent value with new forms and elements of digital technology. Therefore, only by comprehensively understanding the developmental context of Hebei's revolutionary history can we effectively promote the creative transformation and innovative development

of Hebei revolutionary cultural relics. This requires categorizing Hebei's red revolutionary relics, guiding their gene decoding through cultural gene theory, and using cultural and creative products as carriers to contribute to the living inheritance and innovation of revolutionary relics.

1. Overview of Gene Decoding and Digital Intelligence Empowerment for Revolutionary Relics

1.1 Gene Decoding

Under the trend of interdisciplinary studies, the concept of "genes" from biology has been increasingly adopted by design disciplines. The development of cultural and creative products now focuses on extracting genes from cultural phenomena as a new direction for practice. Cultural genes, as the core elements and unique

features of regional culture, encompass history, traditions, values, and symbols. Gene decoding aims to excavate and analyze cultural connotations, forming representative cultural symbols that facilitate understanding and inheritance.

1.2 Digital Intelligence Empowerment

The digital intelligence era provides technological support for the "revitalization" of culture in contemporary times, highlighting the new trend of technology-led, digitally empowered, and integrated

innovative development. Digital intelligence empowerment, guided by the core principle that "protection is the foundation, research is the core, and inheritance is the goal," innovatively practices the protection, research, display, and dissemination of revolutionary relics through digital and intelligent technologies. This integration of revolutionary relics and digital technology represents a new approach to cultural development and inheritance.

The digitization of revolutionary relics involves using digital technologies such as 3D scanning, imaging, and modeling to preserve their original appearance to the greatest extent. For example, 3D scanning, imaging, and modeling technologies are used to create permanent digital resources of revolutionary relics. By summarizing and refining the visual elements of red revolutionary relics through digital symbol design, a database of Hebei revolutionary cultural relics can be constructed, serving as important material for cultural innovation design and contributing to the establishment of a big data system for Hebei's red revolutionary culture, which holds significant value for contemporary design.

1.3 Hebei Revolutionary Cultural Relics and Red Cultural and Creative Products

Hebei Province boasts a leading number and quality of red revolutionary relics in China. According to publicly available data, Hebei has over 1,800 immovable revolutionary relics and 10,805 movable revolutionary relics. These resources provide strong support for the development of red tourism.

Hebei revolutionary cultural relics and sites have endured the test of time. Although the government

has repeatedly used physical protection measures and advanced technologies for reinforcement and restoration, it is well known that cultural heritage cannot be regenerated or preserved forever. In August 2021, the Central Propaganda Department and the Ministry of Culture and Tourism issued the "Several Opinions on Further Promoting the Development of Cultural and Creative Products by Cultural and Cultural Relics Units," emphasizing the need to deeply explore the spiritual connotations of cultural and relic resources, making cultural and creative products important carriers for the public to appreciate Chinese culture and enhance cultural confidence. In this context, the development and prospects of revolutionary relic cultural and creative product design are full of opportunities and challenges. The development of Hebei revolutionary relic cultural and creative products is still in a relatively blank stage. As a product form primarily driven by cultural value dissemination, cultural and creative products also prioritize functional value, supplemented by cultural inheritance concepts, making them practical product forms. Cultural and creative products can play a positive role in the inheritance of red culture and revolutionary relics, allowing consumers to experience classic red relics and spirit subtly through their understanding of these products.

2. Gene Decoding of Hebei Revolutionary Cultural Relics

2.1 Gene Mining and Atlas Construction

Through the dual drive of gene mining and atlas construction, academic research and cultural inheritance are served, providing underlying logical support for the development of red cultural and creative products and the integration of culture and tourism. The gene decoding of Hebei revolutionary cultural relics involves using digital intelligence technologies to decipher the "red codes" behind these relics, systematically organizing, analyzing, and reconstructing their cultural connotations and values. First, the material form genes, including revolutionary documents, artifacts, and sites, are decoded. High-precision 3D modeling and multispectral scanning technologies can be used to establish a "digital

twin" system for revolutionary relics, capturing their physical information and characteristics. Combined with 3D modeling, infrared spectral analysis, and AI image recognition technologies, the physical attributes and implicit information of relics can be extracted. Essentially, this transforms red relics into "decodable, inheritable, and innovative" digital heritage, helping to set a benchmark for the living inheritance of revolutionary relics nationwide.

The requirements of digital technology and public aesthetic needs have raised new demands for structural forms. In the abstract and refined design of Hebei revolutionary relic symbols, simplicity, virtuality, and aesthetics are emphasized. The summary and abstraction of Hebei revolutionary cultural relics focus on the connotation of information transmission and visual impact, making visual symbol forms a prominent feature of visual graphics. Therefore, the digital design of revolutionary relics ultimately explores creative thinking, innovative forms, and visual language. This paper summarizes the distribution of Hebei revolutionary cultural relics, organizing their explicit and implicit genes to determine the direction of gene decoding, which is categorized into form decoding, color decoding, and spirit decoding, as shown in Table 1.

2.2 Decoding the Forms of Hebei revolutionary Cultural Relics

In today's world, multicultural information and visual symbols flood the visual experience of the masses. Among them, there is not only a demand for the ontological interpretation of historical information and cultural tracing, but also more demands from the public for the recognition, generalization, memorability, and timeliness of cultural symbols.

The forms of revolutionary cultural relics are mainly divided into visual and spiritual forms. Under the aesthetic demands of the new era, the design of digital symbols in Xibaipo integrates distinctive regional modeling methods and visual language. Hebei revolutionary cultural relics are extracted based on the essence of visual art form and revolutionary spirit. Among them, visual forms include revolutionary buildings, memorial halls, revolutionary

artifacts, etc. After these intuitive objects are endowed with spiritual meanings, they become flesh and blood. For visual elements, techniques such as photography, extraction, image processing, and modeling can be used to preserve and inherit the original form to the greatest extent possible. But compared to the extraction of revolutionary spirit symbols, it is relatively more complex. For these abstract things, giving them tangible shapes is also a common expression technique in design. To concretize abstract things and give them a specific image, which facilitates people's understanding, memory, and dissemination. Transforming these seemingly abstract and difficult to understand cultures into easily understandable abstract symbols that are more objective, cultural, and digital, establishing a reasonable extraction path for the presentation of their visual elements in different design media and digital carriers.

The paper takes Xibaipo as a typical case to decode its form, first abstracting and refining its material form. As shown in Table 2, five modeling elements were extracted for symbolic design, including the former revolutionary site of the Communist Party of China Central Committee, Xibaipo Memorial Hall, monument, grenade, military number, etc. Taking the former revolutionary site of the Central Committee of the Communist Party of China as an example, the entire building adopts the colors and elements of cave dwelling design, and extracts the shape elements of square and arch for the exterior of the building. And almost every building has a red signboard in front of it, so in the element design, red symbols are also added to summarize the red building form. The Xibaipo Memorial Hall was built in 1977, and the building color continues the colors of the former revolutionary site of the Communist Party of China Central Committee, namely red and earth yellow. In terms of design, geometric shapes are the main focus, specifically refined into triangles and squares. In the design of the Xibaipo Memorial, warm gray and red colors are used, with a hexagonal prism shape topped by a red pentagram. This iconic building records the heroic and legendary story of the revolutionary martyrs of Xibaipo. The shape is concise and powerful, and can be

extracted into a columnar shape. The grenade extracted its appearance and condensed it into two small cylindrical shapes. The military emblem extracted the inverted triangle symbol, and various types of cultural relics were exhibited in the Revolutionary Relics Exhibition Hall at the Xibaipo Revolution Memorial Hall. According to the symbol design method, they were classified and extracted. There are also classic revolutionary relics, daily necessities, and revolutionary artifacts from Xibaipo. The red cultural gene patterns of Xibaipo have been extracted from the manuscript and symbolized.

2.3 Decoding the Color of Hebei Revolutionary Cultural Relics

Accompanied by historical relics and revolutionary artifacts, as shown in Table 3, a systematic sorting is conducted from the perspective of color. In the color decoding of the digital symbolic design of the revolutionary cultural relics in Xibaipo, the color that can express the spirit of Xibaipo is undoubtedly the first choice. Red symbolizes passion, fighting spirit, and revolution, and only red can showcase Xibaipo's revolutionary spirit of hard work and struggle. In the decoding of the colors of revolutionary cultural relics in Xibaipo, extract the color elements from its architecture. From the perspective of color, Xibaipo has been sorted out, and the current color appearance of the entire Xibaipo has basically retained its original appearance. It can be summarized by the eight words "bright party flag, yellow old wall warehouse", and two colors of red and earth yellow have been extracted. For example, the former site of the Central Committee of the Communist Party of China, although it was restored and built in 1971, still adopts the design method of earth yellow cave color as the main color, supplemented by red and brown in terms of layout and form. The Xibaipo Memorial Hall also adopted the colors of the former site of the Communist Party of China Central Committee in its design, with the Xibaipo Memorial leaning towards warm gray on the basis of earthy yellow. For the color extraction of Xibaipo, image processing is mainly used, and there is inaccuracy in color reproduction in online image data. Field shooting is adopted to input the image into PHOTO

SHOP for CMYK value extraction. Compare the hue, temperature, and color tone to highly restore the original appearance, ensuring the accuracy of the color system to the greatest extent possible. It is summarized and refined as natural colors such as earthy yellow, red, brown, black gray, blue gray, and gray.

The digital color design of Xibaipo revolutionary cultural relics showcases the revolutionary spirit of Xibaipo's arduous struggle, which can accurately help the public understand the color characteristics of Xibaipo revolutionary cultural relics and provide design references for designers to carry out subsequent Xibaipo image dissemination and cultural and creative product development.

2.4 Decoding the Spirit of Hebei Revolutionary Cultural Relics

The materialization transformation of revolutionary spirit and culture is a difficult point in research. However, the concretization of abstract things mentioned earlier can be implemented in some related stories. As Xibaipo said in his film, "The last bowl of rice is sent to make military provisions; the last foot of cloth is sent to make military uniforms; the last old quilt is covered on the stretcher; and the last flesh and blood is sent to the battlefield. These can represent the historical witness of the CPC's hard struggle. Based on these moving revolutionary stories, we materialize military provisions, military uniforms, old quilts, etc. In this process, we actually give it the emotion and feelings of revolutionary culture through this object to experience the situation at that time, so as to actively understand the story behind it and achieve the effect of "seeing things and thinking about things". In addition, there are many resounding revolutionary deeds and spirits hidden in the revolutionary cultural relics of Hebei, such as the command of the "three major campaigns in the War of Liberation" here, the birth of the "Two Musts" here, the departure of the "Entering Beijing for the Examination" here, the emergence of New China from here, the "Second Plenary Session of the 7th CPC Central Committee", the "Outline Land Law of China", and so on. Relevant literature and materials have been compiled as support, as shown in Table 4. In

the organization of the material library, a module for red text can be set up to design and systematize red text, which can be directly integrated with cultural and creative products in the later stage. Red text is the easiest and most intuitive way to promote red culture.

3. Design Ideas for living inheritance of Hebei Revolutionary Cultural Relics under Gene Decoding

3.1 The Path of Active Inheritance of Hebei Revolutionary Cultural Relics

As shown in Table 5, by constructing a visual symbol design library for decoding the genes of Hebei's red revolutionary cultural relics, this has played a guiding role in cultural dissemination and design innovation, and is also the foundation of design innovation. The innovation stage is the strategic analysis of symbol design generation. Based on the characteristics of cultural connotation, visual expression, and cultural dissemination, design methods, visual styles, and other modes are determined to find suitable symbol expressions. Centered around the revolutionary cultural relics of Hebei, using core symbols, colors, and styles, in the design and creative stage, on the basis of emphasizing the visual elements of Hebei revolutionary cultural relics, more attention is paid to the functionality of cultural symbol transformation. The combination of symbols and functions strengthens the value of symbol use, and in the inheritance, attempts are made to narrow the distance between consumers and red culture.

The era of digital intelligence has endowed cultural relics with the practical value of "revitalization" in contemporary times. Based on the genetic decoding theory model and driven by digitization technology, new vitality has been injected into the dissemination of Hebei revolutionary cultural relics Province. Using cultural and creative products as a carrier of dissemination, the modern expression of revolutionary cultural inheritance has been highlighted, bringing revolutionary culture closer together, making cultural relics tangible, historically perceptible, and culturally communicable, and exploring the living inheritance of Hebei revolutionary cultural

relics Province Breaking through the limitations of time and space, enhancing the infectious power of the dissemination of red revolutionary culture. To achieve the full chain industry of "protection research dissemination" of Hebei revolutionary culture.

3.2 Research on Contemporary User Needs

The goal of designing digital symbols for Hebei revolutionary cultural relics is to achieve widespread application and dissemination among the public. Therefore, conducting thorough research on consumer demand analysis is the foundation of design innovation, providing important basis for the evaluation of the later design process and design results. To ensure the accuracy of design translation and consumer recognition, this paper selects a decision-making group consisting of 10 design majors, 30 college students, and 10 consumers of cultural and creative products to test the media selection, aesthetic requirements, motivational needs, and potential demand factors for the inheritance of revolutionary cultural relics. Through the analysis and summary of the characteristics of 50 typical consumers, it is determined that consumers tend to favor functional, minimalist, and emotionally charged cultural and creative products in terms of cultural symbols.

Therefore, the main research approach revolves around functionality, fun, interaction, and personality. Cultural and creative products represented by Hebei revolutionary cultural relics are placed in the context of memorial halls, shops, and museums, absorbing and extracting important information such as symbols, culture, and aesthetic values brewed from revolutionary cultural relics, revolutionary sites, and revolutionary deeds. They are combined with contemporary design elements to design cultural and creative products that reflect culture, are rich in beauty, and express emotions with practical value. This provides an explanation and

translation of the connotation of Hebei revolutionary culture. After purchasing, consumers are no longer just sealing the bottom of the box, but are more willing to understand the cultural connotations behind their products through continuous use, so as to convey the culture carried by revolutionary cultural and creative products to

consumers and achieve true cultural output. Therefore, combining two-dimensional symbol design

with three-dimensional modeling, endowing symbols with practical significance, and awakening people's rethinking and understanding of the red culture of Xibaipo from the deep cultural genes and background, is the core of the dynamic in heritage of Hebei revolutionary cultural relics and the best way to spread Red culture.

4.Design Practice of Hebei Revolutionary Cultural Relics and Creative Products under the Guidance of 4-Genes Decoding

Based on the method of decoding the genes of Hebei revolutionary cultural relics, this paper decodes the material theme genes of Hebei revolutionary cultural relics, extracts visual form design symbols, and realizes the specific design scheme of cultural and creative products.

4.1 Design Concept

Applying the visual form extracted from Hebei revolutionary cultural relics, abstracting and extracting the visual form, grafting functions, and translating the red culture of Xibaipo based on the Diversity of the digital age, to make it have strong cultural dissemination and expression. Using the design Elements of Xibaipo and a streamlined architectural style, the exterior silhouette is designed with hollow Iron art, symbolizing unforgettable years and deepening the red spirit.

4.2 Design Presentation

The flash light design for the Xibaipo Memorial Monument, which was led by the author, selected the abstract form of the memorial tower in the architectural elements of Xibaipo and considered the relationship between The form and function of the building and its products. So I thought about products related to the columnar shape, and the form of the Xibaipo Memorial Tower was grafted with this symbol as a design element. It can Also be said that the columnar product structure uses this symbol as a design element, arousing consumers' hearts to remember that revolutionary achievements are hard won and cherish the present through the use value Of the product. Xibaipo oil paper umbrella deeply

explores Xibaipo culture from color to form. In terms of overall design creativity, the extracted Xibaipo elements are interpreted from color to form, using the core color system of Xibaipo, namely earthy yellow and red, to express the impression of the central site of Xibaipo. From color to design, it expresses a strong revolutionary atmosphere. Interms of the handle design, the Shape of the Xibaipo Memorial Tower was chosen, which perfectly fits the grip shape and brings consumers closer to Xibaipo culture, as shown in Figure 6.

Hebei revolutionary cultural relics are inevitably being gravaged by time. "Digital cultural relics" and "cultural and creative relics" are important attempts for permanent protection, in order to preserve The spirit of Xibaipo in our sight and memory for a longer time. The digital visual symbol design of Hebei revolutionary cultural relics is transformed into tangible products, based on decoding the content of Revolutionary cultural relics, extracting, abstracting, and organizing their symbols. With the help of Contemporary digital visual expression technology, it deeply integrates with contemporary tangible products and functions, allowing consumers to interact with the products and create representative creative designs that are easy for consumers to accept and have Hebei revolutionary cultural relics.

5. Conclusion

The paper uses digitization and intelligence to decode the genes of Hebei revolutionary cultural relics, creating a distinctive cultural gene system for revolutionary cultural relics. Through cultural and Creative products as carriers, cultural genes are transformed, and the dissemination of cultural and creative Products drives the living inheritance of revolutionary cultural relics. Finding entry points and combining Them with regional culture and spiritual connotations to activate the revolutionary cultural heritage genes, Integrating revolutionary cultural and creative heritage into people's lives, truly realizing the dynamic Inheritance of revolutionary cultural heritage, strengthening consumers' recognition of red culture, and Relying on digital technology to promote innovation and upgrading of the revolutionary cultural

industry. The concept of gene decoding is applied to cultural and creative products, and the design principle of red Cultural and creative products is proposed, which takes "revolutionary cultural relics" as the carrier and "revolutionary spirit" as the connotation. Revolutionary cultural relics are materialized into creative Products in a three-dimensional way, endowed with practical functions. Taking the Xibaipo flashlight and oil paper umbrella as examples, the cultural and creative product design of decoding the genes of Hebei revolutionary cultural relics is demonstrated. This study proposes a new research perspective for promoting The development of red culture and red cultural and creative design. Even though the material form of Hebei revolutionary cultural relics will gradually disappear in the coming years, revolutionary cultural Relics will take root and sprout under the protection of digital technology, and their cultural and creative Products will continue to be preserved and heard by consumers.

6. References

- [1]Feng Dakang, Zhang Qingrong. Research on the Urban "Revitalization" of Regional Cultural Genes in the New Silk Road Belt[J]. Popular Literature and Art, 2018(13):240-241.
- [2]Yu Jing, Zhao Lu, Shi Jinyu, et al. Research on Big Data Visualization Design of Red Culture Gene Map [J]. Decoration, 2021,(09):126-127.
- [3]Tang Liying. Red Gene Map and Cultural and Creative Research of Long March National Cultural Park[J].Design, 2024(37):56-58.
- [4]Gan Lu, Analysis of Visual Design of Red Culture Information[J]. Screen Printing, 2024,(07):106-109.
- [5]Wang Hui, Research on the Digital Active Path of Revolutionary Cultural Relics in the 5G Era[D]. Shaanxi University of Science and Technology, 2022.
- [6]Wei Hong, the Path of Digitally Empowering the Protection and "Revitalization" of Revolutionary Cultural Relics-Taking Guangxi Revolution Memorial Hall as an Example[J] New Legend, 2024(15):110-111.
- [7]Qiu Hui, Research on Building Digital Empowerment for the Protection and Utilization of Red Resources [J]. Party History and Literature,2022(07):58-60.
- [8]Liang Shuang, Empowering with Intelligence to Promote the Revitalization of Red Resources[J]. Party History and Literature, 2025(05):75-76.
- [9]Yang Mei, Research on Cultural and Creative Product Design Based on Yellow River Culture Gene Decoding[J]. Industrial Design, 2024(11):130-133.
- [10]Gao Guanghuan, Fan Ruike. The Dual Situations and Implementation Paths of Digital and Intelligent Technology Empowering the Inheritance of Yimeng Red Culture[J]. Cultural Journal. 2025(01):8-12.
- [11]Lu Chunmei. Research on the Construction of Red Cultural Symbols and Decoding of Red Genes in Jingchu over the Past Century[J]. Comparative Study of Cultural Innovation 2023,7(23):81-85.
- [12]Xing Chihong. Innovative Design Empowers Red Cultural Creativity to Ignite a New Engine for Cultural Heritage[J]. Yunnan Pictorial. 2025(05):54-55.
- [13]Nie Cunyu. Research on Teaching Strategies of Chinese Revolutionary Cultural Works in Senior High School [D].2022.
- [14] Li Xingming, Li Xiaoling, Shi Pengfei, et al. Research on the Integration Path of Rural Literature and Tourism based on Homesickness Cultural Gene Decoding [J]. Journal of Southwest University (Social Sciences Edition).2024,50 (1). DOI: 10.1718/j.cnki.xdsk.2024.01.013.
- [15] Liu Changlin. China's Systematic Thinking: Cultural Gene Perspective [M]. China Social Sciences Press, 1990.
- [16] Zhao Juan, Zheng Minglei. Discussion on Cultural Blending and Design Innovation [J]. Art Panorama.2014, (9). DOI: 10.3969/J.ISSN.1002-2953.2014.09.071.
- [17] Cheng Jinlong, Wang Shuman. Rural tourism helps rural revitalization: theoretical construction and regional practice [M]. Social Sciences Academic Press (China), 2022.