Artificial Intelligence Driven Promotion of Cultural Heritage Protection in the Context of Harmony Rural Construction

Xiujuan Wu

Abstract: In order to use digital technology to protect intangible cultural heritage and regional culture, the innovative digital design of intangible cultural heritage is put forward from the perspective of Internet. This paper puts forward a collaborative innovative design method of "root carving technology+digitization". Taking "Zhu Zhanghuis lecture" in Yuelu Academy as the representative, this paper explores the innovative methods of developing scene-based root carving products by regional culture. The results show that the acceptance of using light-cured resin as the accessory of root carving is not high, and the proportion of people in the industry who appreciate or accept it is only 71.3%. Developing the design around the basic model is conducive to improving production efficiency, ensuring the improvement of efficiency while retaining the uniqueness of hand-made. The whole root carving product has a certain artistic conception, and can appreciate the connection with the concept of time, but the specific story can be strengthened. Conclusion: Integrating the situational story method into the root carving design of Hunan School can enhance the overall atmosphere and story of the root carving works, enhance the story of the root carving cultural and creative products of Yuelu Academy, and be conducive to the promotion and dissemination of regional root carving culture and academy culture.

Keywords: root carving; Digitization of intangible heritage; Digital design; collaborative design

1 Introduction

The trend of the combination of culture and industrial manufacturing in China puts forward the actual demand for creative design, that is, to study the common key technologies based on China style, take cultural heritage (especially intangible cultural heritage) as a typical sample, study the cultural ecology, cultural forms and expression methods of China's historical development, as well as regional cultural differences and cultural values, comprehensively analyze the design elements of China's aesthetic characteristics, construct a framework model of China style, and realize the development of Chinese style design to intelligence and high-end. Intangible cultural heritage preserves national individuality and national aesthetic habits in a "living" state, and contains the unique spiritual value, thinking mode, imagination and cultural consciousness of the Chinese nation, which is the basic basis of China's design style and the classic cultural elements and prototype [1]. Because of its intangible, dynamic, spatio-temporal characteristics, the increasing and accelerating globalization and
modernization process have led to great changes in domestic cultural ecology, and the protection and development of intangible cultural heritage with sound, image and skills as the means of expression has encountered great challenges. In recent years, through database construction, digital application and big data analysis, digital technology provides a technical platform for the recording, preservation and dissemination of intangible cultural heritage in China, and also provides a new way for the inheritance, innovation and development of intangible cultural heritage. At the same time, many problems still exist, such as: ① the research topics of intangible digital protection are relatively scattered, and there is no scientific protection model for the whole life cycle management of intangible digital information from the overall view of intangible resources; (2) Pay attention to presenting intangible cultural forms, and lack the display of intangible cultural structure and significance to explore the internal mechanism of non-genetic inheritance and innovation; ③ It is difficult to show the vitality of intangible cultural heritage and reflect the cultural creativity of inheritors [2]. In order to inherit and develop intangible cultural heritage, realize the activation and creative utilization of intangible cultural heritage, the concepts of participatory digital protection and productive protection came into being, which supported giving inheritors and owners the right to participate in digital protection, fully exploring the potential social and economic value of intangible cultural resources, and promoting the development of cultural industries through the transformation of creativity, creativity and innovation [3].

2 Literature review

Due to historical reasons in Italy, many intangible cultural heritages are scattered in private and church hands, which leads to many difficulties in practical protection. In order to solve this problem, Xu, Z. and others set up a society to manage and strengthen the sharing of these resources. The main work is registration, sorting and other control work, which makes further protection more convenient. For example, the "Internet Cultural Heritage Project" was established to provide people with resources that can be queried online. The system can integrate the resources of libraries and other related cultural institutions, and facilitate people and other institutions to obtain digital resources of intangible cultural heritage through online platforms and other channels [4].

The digital protection of French intangible cultural heritage in its national library has developed well. In 2003, the digital project Gallica completed the historical introduction of thousands of illustrations and related documents, nearly 10 million books and hundreds of thousands of still images. Król, K. and others started "Digitization of Cultural, Scientific and Educational Contents", which belongs to the project of "Investing in the Future" and planned digital cultural skills, mainly in the fields of books, music and images [5].

The research on intangible cultural heritage in China started late, starting in 2003, when the UNESCO Committee of the National Peoples Congress drafted the Draft Law on the Protection of Traditional Ethnic and Folk Cultures in Peoples Republic of China (PRC), which was later renamed the Law on the Protection of Intangible Cultural Heritage in Peoples Republic of China (PRC) (draft). In 2004, China became the sixth country to join the Convention for the Protection of Intangible Cultural Heritage, and it was not until recently in 2011 that the Peoples Republic of China (PRC) Intangible Cultural Heritage Law was formally implemented. As people pay more and more attention to intangible cultural heritage, relevant theoretical works on intangible cultural heritage are also emerging one after another. Xie, R. and others have expressed their
opinions. For example, The Paradox and New Path of the Protection of Intangible Cultural Heritage, The Origin, Current Situation and Related Issues of the Concept of Intangible Cultural Heritage, and Intangible Cultural Heritage Towards the Concept of Discipline have all sorted out and understood the definition and concept of intangible cultural heritage. For example, Protection and Utilization of Intangible Cultural Heritage, Re-understanding of the Characteristics and Protection of Intangible Cultural Heritage have made their own interpretations on how to protect intangible heritage [6]. The research on intangible cultural heritage abroad started earlier than that in China. Nikolakopoulou, V. and others first forward the concept of "intangible cultural wealth" and promulgated the Law on the Protection of Cultural Property to define its category [7]. Cui, C. and others also promulgated relevant laws in 1962 to regulate their country's cultural property. It was not until the adoption of the Convention for the Protection of the World Cultural and Natural Heritage in 1972 that the worldwide protection activities officially began. In this Convention, the proposal on intangible cultural heritage was put forward for the first time. Although the proposal was rejected at that time, with the development of time, the concept of intangible cultural heritage was put forward and put on the agenda again with the attention of relevant government departments. It was not until 2003 that UNESCO promulgated and adopted the Convention for the Protection of Intangible Cultural Heritage, in which the connotation of intangible cultural heritage was clearly defined [8].

The main purposes of this product survey are: to understand the acceptance of "Zhu Zhang Zhi Hui" in the root carving industry; Discover the shortcomings of the product; Find the part with high user recognition and analyze the competitive advantage of the product. In this digital scene root carving design, the design method is quite different from traditional root carving products, and there is some innovation in the application of materials with scene root carving products. It is very important to investigate the market acceptance of innovative products.

3 Research methods
3.1 sketch design

Sketch is a key link in the initial stage of design, and it is an informal form used to describe the general idea of design. Based on the investigation, analysis and derivation process mentioned above, the project team will fully imagine and associate with the user perception model and product positioning, and complete the preliminary modeling design of root carving products with full conceptual sketch design.

3.1.1 Concept sketch scheme

In the design process, the design requirements are often put forward in the form of keyword description and oral communication, or by collecting excellent similar designs to form an image version [9]. Designers need to use fragmented information and elements to guide the direction of subsequent design, and at the same time, they need to decompose and integrate the fragmented information elements semantically to form a complete design scheme.

The purpose of conceptual sketch scheme design is twofold. First, the important innovation of this root carving design is the application and integration of resin materials, which need to be integrated in conceptual design [10]. Secondly, the focus of the scene-based root carving is to make the theme of the story clear, and the conceptual design should be carried out under the principle of ensuring cultural identity and recognition, reflecting the core spirit of Zhu Zhanghuis speech. There are two basic types of root
carving suitable for the theme of Zhu Zhanghui's lecture: ring type and tree type. It is necessary to complete the conceptual modeling design by constantly updating, iterating and trying the sketches around the two basic types and related design elements.

The design elements mainly focus on the relevant intention extraction of Zhu Zhanghui. In the story told by Zhu Zhanghui, in the category of humanistic elements, there are two people, Zhu Zhanger and the audience, and the architectural elements include lecture hall and Hexi platform. There are many text elements in inscriptions and poems. Among the natural elements, there are ginkgo leaves in the autumn of Yuelu Mountain, which contain the meaning of time and study; There is Ziyang Cinnamomum camphora planted by Zhu Xi for Meiji learning ambition; White horses led by people who drink horses [11,12]. By following the above design principles and using elements reasonably, we can design related scene root carving products around the story.

According to the images related to Zhu Zhanghui's lecture, the relevant elements were extracted and iterated, and three preliminary conceptual sketch schemes were formed through the design of elements and root carvings.

Conceptual sketch scheme 1 mainly revolves around the concept of "applying the practice". This design hopes to integrate the concept of "thousand-year inheritance and applying the practice" mentioned by Zhu Zhanghui into the works, which tells the story of the Millennium changes of an academy after Zhu Zhanghui's speech. The basic form of the whole modeling uses a ring shape, hoping to create an atmosphere that crosses just visiting. Looking back at the past years through the traces of old trees, after thousands of years, the spirit will last forever [13]. The works mainly embody three elements, namely, Ginkgo biloba, Ziyang camphor and Zhu Zhang, all of which are associated with the event of "Zhu Zhang will speak".

The second concept sketch scheme is to reproduce the core scenes of speaking. This scheme takes Zhu and Zhang as the core design elements, adds simplified elements that can reflect the school scenes, uses tree-shaped modeling as the basic form, and restores the speaking scenes with minimalist language. I hope to restore the scene told by Zhu Zhanghui simply and directly. The past events turned white and remained in my memory, and the old trees at that time stood here and made people forget history.

The inspiration of the concept sketch scheme 3 is the influence on the generations of the academy after the lecture. This scheme hopes to depict the passage of time after Zhu Zhanghui's lecture in a more subtle way, but the spirit of the lecture will last forever. The white horse symbolizes that time passes like a white horse, and it is also the unprecedented grand occasion of drinking horse pond in front of the academy when Zhu Zhanghui speaks.

3.1.2 Concept sketch scheme evaluation

After the above conceptual sketches were evaluated and reviewed by the project team, the first creative scheme was finally chosen, that is, the design around the concept of "practical application".

The members of the project team believe that the design of the first scheme can intuitively express the theme of Zhu Zhanghui, and the elements used are also familiar to the target audience. The whole scene has a certain sense of time travel, the composition is more creative than the second scheme, and the story is more clear than the third scheme. Although the story of the second scheme is clear, the overall design language is too straightforward, and the craftsmanship of the root carving part is not as good as other schemes. The overall artistic conception of the third scheme is good, but the white pony is used to show the grand occasion of many horse drinkers when Zhu Zhanghui speaks, and it implies the concept of time passing, which has certain connotation, but the story...
is obscure, which does not highlight the advantages of situational root carving in telling stories, and the story is too weak for readers to watch. To sum up, the first concept is the design direction of this root carving design.

Deepen the connotation and form design of the elements in Scheme 1, and the specific meanings of the elements used are:

1. Ginkgo biloba in the Academy: When Zhu Zhanghui talked about it, it was in the autumn of Lushan, and ginkgo was in full bloom. At the same time, Ginkgo biloba means "eternal", and it is an eternal witness when the essence of traditional culture is scattered and passed down from generation to generation [14].

2. Ziyang camphor tree: Zhu Xi planted a camphor tree behind the school after Zhu Zhanghuis lecture. After thousands of years, it has become a towering tree. It happens that this material is a hollow old camphor tree. Both of them have the meaning of growth, development and inheritance. The material and story are very appropriate. Moreover, Zhu Xi once planted camphor trees in his hometown and became famous. The element of camphor trees bears Zhu Xis spirit of constantly pursuing and surpassing himself in academics, and it is also a response to his parents expectations, which is integrated with the spirit of an academy in a Millennium university.

3. Zhu and Zhang: Zhu and Zhang are the soul figures of this story and the founders of the academys thousand-year history. Characters are the core part of the scene root carving, so it is necessary to restore the posture that Zhu and Zhang can speak as much as possible.

Through the deepening process of element connotation and form design, the preliminary design scheme is obtained. The elements used are Ginkgo biloba leaves, Zhu Zhang and Ziyang Cinnamomum camphora in an academy, and the root carving style adopted is ring-shaped.

3.2 root carving renderings design

Rendering design is a common design display method in the early stage of design, which can transform conceptual design into concrete and visible visual expression and help designers express and spread their own design ideas. The ultimate goal of renderings design is to transform the conceptual design into the final product according to the realization of renderings [15]. The cost of trial and error can be effectively reduced by designing the renderings for root carving products. According to the evaluation results of the conceptual sketch scheme, the project team took the deepened design scheme as the prototype and designed the renderings after shooting the physical drawings of the root wood. The environment of the renderings is set in a scene that reflects certain soothing emotions, and the overall color is warm, highlighting the wooden texture and natural softness of root carving products.

3.2 Digital model design of root carving

According to the design of the sketch of the creative idea, the selected ring root material is measured to facilitate the fitting of the size and proportion in the subsequent application of related elements. The production of 3D digital model will be divided into two parts, which are modeled and rendered by digital technology on the computer respectively.

Image source: The first part of the authors self-drawing is the rough root mould showing the overall product space structure, and the rough root mould is modeled on the computer with C4D software. The main purpose of making a rough heel model is to facilitate the subsequent adjustment of the proportion, collocation and size of different elements, and to find the most suitable spatial structure of the root carving product.
The second part is to make printable models of some characters or elements and integrate them into the scene root carving products as innovative elements in the root carving products. The model that can be printed is different from the rough model, so it needs to be made into a high-precision model, which is called high-precision model for short. The model must be a complete solid model with wall thickness, and the accuracy requirement is relatively high. There are three elements involved in the work: Zhu and Zhang, Ginkgo biloba in the Academy and Cinnamomum camphora in Ziyang. In this innovative design method, the resin material model is combined with root carving products, and the rough model of the above three elements in the material library of an academy built in the previous article can be used, and then further fine-tuning and adaptation can be carried out. Among them, Zhu Zhang and Xueyuan Ginkgo need to print, so they need to make a high mold. Ziyang Cinnamomum camphora is realized by traditional carving, and the final effect is uncertain with the materials. Therefore, the model only needs to be used to make the overall effect diagram of the product, because it needs to be refined and modified on the basis of the rough mold in the material library.

The combination and construction of ginkgo leaves were carried out. Firstly, the preliminary modeling is completed by C4D software. Because of the need for 3D printing in the future, it is necessary to refine the model to ensure that the ginkgo leaf is a model with solid and wall thickness, and the thickness should not be too thin. Secondly, because the leaves have a certain thickness, they need to be combined and deleted on the computer in advance, and the shape needs to be matched reasonably. After many combinations and adjustments, the design of the whole ginkgo leaf shape has been completed [16]. Finally, because the Ginkgo biloba leaves are thin and small in size, there is no need to hollow out the model, and after the combination of the models, you can wait for the subsequent printing and effect presentation.

The rough models of Zhu and Zhang were extracted from the material database of the project team, and the model was modeled by reverse engineering in the preliminary research of the "Virtual Academy" project. After model refinement, reduction and combination adjustment, and hollowing out, the model design of Zhu and Zhang was completed. Finally, the rough model of root material modeling is combined with the model of material, and the three-dimensional structure effect of the whole scheme is obtained.

3.3 Product physical display

After the completion of the work, the product display map is photographed, and the whole photographic environment conforms to the characteristics of the product. The key words of product positioning are soothing, culture, creativity, Zen, academy stories, wood and so on. As a whole, a warm yellow tone is adopted, and traditional cultures such as root carving products and tea culture can be well integrated, and integrated with the whole environment of log tone, creating a peaceful and quiet Zen.

3.4 Dynamic interactive display process

After the design of dynamic interactive program is completed, the pictures and model materials that need to be used should be integrated to present better visual effects. The key words of product positioning are soothing, culture, creativity, Zen, academy stories, wood, etc. Combined with the final effect of product positioning, the warm yellow color tone is adopted in the design of the whole interactive process, and the photographed product physical map is put into the environmental effect map which conforms to the characteristics of the product. In the process of interaction, we should add some dynamic graphic display elements in visual design. Through the addition of dynamic graphics, the positioning of root carving products can be strengthened, giving
the whole quiet, warm and soothing mood, so as to enhance the emotional experience of users. In terms of interaction, the function needs to be as simple as possible, mainly showing the appearance and function of the product clearly. Based on the above analysis, it is designed that the "Zhu Zhang Zhi Hui" dynamic interaction is the emotional version of visual design.

Combining the product positioning of "Zhu Zhang Zhi Hui" with the users use scene, the background picture of the scene used in this dynamic interactive exhibition and the decorative elements used are made in photoshop software through partial shooting and partial drawing.

The static frame of the dynamic interaction process finally output by the computer display program is divided into the following processes:

1. After loading, enter the cover page and click the "Learn More" button to enter the subsequent physical display section.
2. The user is prompted with the function of the products incense burner by words, and the user moves the sandalwood on the desktop to the incense mouth at the top of the root carving product and lights the backflow sandalwood.
3. After the user lights sandalwood, the smoke slowly floats out with time.
4. Smoke wafts out and gradually becomes rich. At this time, users can view the three-dimensional model of the product from multiple angles through text prompts, and users can enter the viewing screen of the three-dimensional model by rotating the model.
5. After entering the model display screen, the user can rotate and watch the 3D model within a limited angle by zooming in, zooming out and rotating. After 10 seconds, the prompt button "Return to Home Page" appears.

Through this dynamic display process, users can appreciate the details of the product, and at the same time, they can understand the product functions more intuitively and feel the usage scene of the product.

4 Result analysis

4.1 User feedback survey

4.1.1 User product feedback

The main positioning of this product is nature, Zen and leisure, and the user groups are mainly tourists, traditional culture lovers and root carving product lovers. According to the theory of usability testing, it takes 15 test users to find out all the existing problems in the product testing. According to this theory, 15 young tourists, fans of Hanfu, Chinese studies and tea culture were invited as typical representatives of user groups to experience products and interactive programs.

The users experience process is divided into two parts, the first part is the experience of interactive programs, and the second part is the evaluation and suggestion of the final works. Summarize the suggestions given by users as follows:

1. Some details of digital sculpture design are not enough, and the reduction degree of characters can be further improved. As a root carving product, there are few hand-carved parts, so the craftsmanship of the details can be stronger [17].
2. In the animation part of the function demonstration, the incense is put into the incense mouth and automatically ignited, which can increase the link of users own ignition, and design the matching ignition tool to improve the whole experience process.
3. The operation of the interactive program is slightly stuck, which is not smooth and natural enough, and the smoke effect produced in the animation is not realistic
enough, which affects the overall atmosphere and sense of substitution. Collect and sort out the feedback data of 15 users, and get the user feedback table in Figure 1.

4.1.2 Root carving industry feedback survey

At the same time of design innovation, it may cause destructive innovation, and it is impossible to gain the sense of identity of specific culture-related enthusiasts, practitioners and inheritors. The attitude of craftsmen towards technical intervention and the sense of innovation are an important part of the collaborative innovation process of handicrafts and digital technology [18]. In the design of root carving products in this innovative scene, the materials and design flow are quite different from other root carving products, and there will be many new performances in the final presentation effect. Therefore, it is necessary to visit people in the root carving industry for evaluation and suggestions for subsequent improvement and creation.

Use questionnaires and face-to-face interviews to conduct a comprehensive return visit survey. Firstly, in the form of questionnaire, a survey questionnaire was distributed to 80 root carving craftsmen, root carving market merchants and root carving collectors, with a recovery rate of 100% and an effective rate of 100%. Because of the innovative application of resin materials in this paper, the acceptance of traditional root carving art practitioners is highly uncertain, so it is evaluated and the acceptance table of resin/nylon and other 3D printing materials by root carving industry practitioners is obtained [19]. Synthesize the contents of other investigations related to this root carving product, sort out and analyze the data, and get the basic identification degree, artistic evaluation, commodity evaluation and other data of this product as shown in Table 1. Evaluation score $S_i$ Calculate according to the following formula (1):

$$S_i = \frac{\sum_{l=1}^{80} s_l}{80 \times 5}$$

Among them, $s_l$ Represents the score of an evaluation index. According to the results, several practitioners with very different views were selected for further follow-up interviews. The representative evaluations and suggestions obtained are as follows:

**Table 1. Feedback data of root carving industry insiders on "Zhu Zhangzhihui"**

<table>
<thead>
<tr>
<th>evaluating indicator</th>
<th>score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aesthetics</td>
<td>4.1</td>
</tr>
<tr>
<td>artistry</td>
<td>4.0</td>
</tr>
<tr>
<td>territoriality</td>
<td>3.6</td>
</tr>
<tr>
<td>functionality</td>
<td>4.2</td>
</tr>
</tbody>
</table>

**Figure 1. User experience feedback**
1. The acceptance of using light-cured resin as the accessory of root carving is not high, and the proportion of people in the industry who appreciate or accept it is only 71.3%. The insiders suggest that this accessory can be made into a detachable part or an alternative scheme of ceramic parts can be provided to provide users with more choices, which should get better feedback from the root carving market.

2. Developing the design around the basic pattern is beneficial to improve the production efficiency, and the requirements for the skill threshold of craftsmen are lower, but the artistry is also reduced. In the application of elements in a single part, more design schemes should be provided according to the different details of root materials, and the adjustable range should be expanded to ensure the improvement of efficiency while retaining the uniqueness of hand-made.

3. The whole root carving product has a certain artistic conception, and can realize the connection with the concept of time, but the specific story can be strengthened.

4.2 Outlook: "Handicraft+Digitalization" Collaborative Innovation to Build a Regional Cultural Ecology

The so-called regional cultural ecology is a system that integrates many internal and external factors that constitute the regional cultural system and the interaction between them. The value of studying and constructing regional cultural ecology lies in that the intangible cultural heritage can be developed and passed down naturally and healthily through production and lifestyle, which is more dynamic and open than the independent inheritance of culture. Therefore, constructing regional cultural ecology is an effective method to revitalize regional culture at present [20].

Through the mode shown in Figure 2 below, handicrafts and digitalization work together to build a regional cultural ecology. In this collaborative innovation process, handicrafts and digital technology depend on each other, handicrafts can provide value support and cultural support for digital technology, and digital technology can enhance the execution of traditional handicrafts, and innovation and scientific and technological strength complement each other and innovate together.

Taking the root carving in Hunan as an example, digital technology has been incorporated into the traditional technological process, and the communication efficiency in the design demand stage can be improved by quickly drawing conceptual sketches; Through real-time collaborative design, the direction of the conception and deepening stage is ensured to be accurate, and the cost in the modification process is correspondingly reduced; Through digital technology, the types of root carving materials, artistic forms and display methods are improved in the design and implementation stage.

In the future development, through the similar collaborative innovation design method of "handicraft+digitalization" in this paper, digital technology can be more deeply involved in the design and production process of handicrafts, further enrich and improve the cultural ecological construction of different regional cultures, attract more human and material resources to invest in it, produce a more perfect design and production process, and produce more products with the unique ingenuity of traditional handicrafts and the aesthetic and value orientation of modern people.
5 Conclusion

(1) "Handicraft+Digitalization" collaborative innovation design
This paper summarizes the problems existing in the current root carving industry, analyzes the feasibility and advantages of digital design involved in root carving product design, and puts forward the method of "root carving technology+digitalization" to jointly build the regional cultural ecology of Huxiang. Taking "Zhu Zhanghui's lecture" in an academy as a representative, this paper explores the innovative methods of developing scene-based root carving products in Huxiang regional culture. At the same time, three-dimensional printing products are innovatively added to the root carving design, which enriches the expression forms of products.

(2) The situational story method is applied to the root carving design of an academy. Integrating the situational story method into the root carving design of an academy enhances the overall atmosphere and story of the root carving works, which can enhance the story of the root carving cultural and creative products of an academy and provide reference for the development of other products. At the same time, the style of root carving in Hunan is used in the products, which is conducive to the promotion and dissemination of root carving culture in Hunan and the culture of an academy.

(3) Study on the basic type of root carving.
Through market visits and online surveys, the characteristics of root wood suitable for the scene were found, the characteristics of several basic types were summarized, and the method of integrating design elements and product functions into the basic types was put forward to ensure the batch production of root carving products while maintaining the ingenuity and natural beauty.

(4) Interactive program design for handicraft exhibition.
The dynamic interactive display design of handicraft product function and shape is carried out, and the interactive program is built by TouchDesigner. Through the dynamic display process, users can appreciate the details of handicraft products, and at the same
time, they can understand the product functions more intuitively and feel the usage scene of the products.

References