



Digital Art Innovation of Traditional Culture: A Case Study on Huangmei Cross Stitch Embroidery in Hubei Province

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Abstract. In the digital age, the rapid development of science and technology has profoundly changed the lifestyle and the way of conventional culture communication. As a traditional folk art of Hubei Province, Huangmei Cross-stitch is also faced with unprecedented challenges and opportunities in the process of inheritance and development. On one hand, the prevalence of fast-paced life and diverse cultures has restricted the development of traditional culture; on the other hand, the rise of digital technology has provided new method for the development of conventional culture. This article explores the innovative design based on Huangmei cross stitch patterns, and combine Touch Designer software to carry out dynamic innovative design of the patterns, so as to provide an innovative practical path for the development and dissemination of folk culture.

Keywords: digital art innovation, traditional culture, Huangmei cross stitch embroidery

1 Introduction

With the rapid advancement of digital media technology and the booming development of global cultural creativity, the digital inheritance and innovative revitalization of traditional intangible cultural heritage (ICH) have become core topics in contemporary cultural research and design practice worldwide. Huangmei Cross Stitch Embroidery, a national intangible cultural heritage originating from Huangmei County, Hubei Province, represents a typical folk embroidery art in central China. This study extracts core cultural and visual genes suitable for digital transformation. Combined with modern digital art creation technologies and innovative design concepts, it breaks the shackles of traditional craft expression, explores diversified digital innovative expression forms and cross-field application scenarios, and constructs a sustainable digital inheritance and innovation system for Huangmei Cross Stitch Embroidery.

2 The Background of Huangmei Cross-stitch

2.1 The History of Huangmei Cross-stitch

Huangmei is located in the eastern part of Hubei Province, adjacent to Jiangxi and Anhui provinces. It is a place where Wu and Chu cultures integrate and interact, boasting a profound cultural accumulation. Huangmei Cross-stitch, also known as "Shizi Tiaohua", was once widely used among the people in Huangmei (Zhao, 2014). Geographically, the southern part of Huangmei is a vast alluvial plain with a long history of cotton cultivation, which has provided a solid material foundation for the formation of Huangmei Cross-stitch (ibid).

Huangmei cross-stitch is a traditional folk art in Hubei Province with long history. Yand and Su (2018) present it is originated in the Tang and Song Dynasties and the it is a creation made by rural women in their spare time from daily work to decorated daily necessities at first. In the prosperous culture of Tang and Song Dynasties, the Huangmei cross-stitch achieved full development, to more specific, the art form of cross-stitch gradually became popular among local women and the early works were almost decorations for simple daily items such as headscarf and clothes. By the Ming and Qing Dynasties, the development of Huangmei cross-stitch had matured (ibid).

Nowadays, Humei cross-stitch has also experienced a new stage. Zhao (2014) cliam Huangmei cross-stitch has won many awards in many domestic and international exhibition including the gold medal at the Panama International Exposition in 1938 and an award at the Folk Arts and Crafts Exhibition of Socialist Countries in Poland in 1954. These honors made Huangmei cross-stitch well-known and have brought it to the international stage. In 2006, Huangmei cross-stitch has been listed in the National Intangible Culture Heritage List. After four years, General Administration of Quality Supervision, Inspection and Quarantine of the People's Republic of China Approved the implementation of geographic indication production for Huangmei cross-stitch. This series of measure have provided innovation development of Huangmei cross-stitch in contemporary society.

2.2 The Artistic Feature of Huangmei Cross-stitch

1) The unique techniques

Huangmei Cross-stitch is a highly distinctive embroidery craft. Different from ordinary embroidery that emphasizes "stitching", it focuses on "cross-picking". It uses local hand-woven cloth, known as Yuanqing cloth, also called dark indigo cloth, as the base. Craftsmen use a single needle and a single thread to create cross-stitches on the grid formed by the intersecting warps and wefts of the base cloth (Zhao 2014). According to Hu Dewen, a cross-stitch craftsman, a pattern has only one thread knot at both its start and end. Specifically, Yang and Su explain the point where the needle is first inserted and the point where the thread is finished after the pattern is completed are the same. These exquisite craftsmanship requirements reflect the uniqueness and artistic value of Huangmei Cross-stitch, as well as the craftsmen's persistent pursuit of skill and rigorous attitude. What is more, the creator of Huangmei cross-titch generally

create exquisite pattern on the cloth solely by hand sensitivity and previous experience without relying on any draft. This technique of embroidery contribute the cross-stitch works be equipped with smooth lines, amazing pattern and full of attraction (Zhao, 2014).

2) Diversity pattern themes

The patterns of Huangmei Cross-stitch cover a wide range of themes, including natural scenery, myths and legends, folk stories, and opera characters. Yang and Su (2018) demonstrates that these themes reflect the local people's daily lives, beliefs, and aesthetic values. Table 1 provides the different pattern of Huangmei cross stitch. In terms of natural scenery themes, common motifs include flowers, birds, insects, fish, landscapes, and trees. For example, the pattern "Phoenix and Peonies": the phoenix, known as the "king of birds," symbolizes auspiciousness, beauty, and nobility, while the peony stands for prosperity. The combination of the two implies "prosperity and good fortune." Zhao (2014) gives another example is the pattern "Carp Leaping Over the Dragon Gate": the carp striving to jump over the dragon gate represents people's aspiration for bright future and successful career. And these natural scenery patterns are vividly presented on the cloth with full of passion and wishes from local people. Beside, myths, legends, and folk stories are also common themes in Huangmei Cross-stitch. For instance, Yang and Su (2018) presents that the legend of "Cowherd and Weaver Girl" is depicted through cvivid patterns showing the couple's meeting on the Magpie Bridge, which conveys the best wishes of happy and fulfilling love. Yang and Su (2018) also discuss that these patterns based on myths, legends, and folk stories not only have artistic appreciation value but also play a role in inheriting and spreading traditional culture. They allow future generations to understand and remember these classic stories while admiring the cross-stitch works.

Table 1. Different pattern of Huangmei cross stitch

Category	The classic pattern			
Animals				
	phoenix	fish	dragon	dog
Plants				
	peony	lotus	pomegranate	Lily

folk tale		
	traditional Chinese wedding	The Seven Fairies
Words		
	longevity pattern	swastika pattern

3) Bright color application

The color application of Huangmei cross-stitch is distinct and unique, featuring a strong local style and powerful visual impact. Rooted in the cultural context of the ancient Chu region, it boasts brilliant colors, a distinct and unique character, and a lively quality. The color of Huangmei cross-stitch also bring remarkable visual aesthetics and decorative effects for audiences. Huangmei cross-stitch typically uses solid-colored fabrics as the base, with navy blue, black, white, and red being the most commonly used base colors (Zhao, 2014). For color treatment, it relies heavily on primary colors and deep shades that one or more basic patterns are unfolded in a sequential manner, and multiple colors are used alternately, resulting in a bright, rhythmic effect. Figure 1 shows the classic color of Huangmei cross stitch. Zhao (2014) presents Huangmei Cross-stitch emphasizes the "strong contrast" of colors, it highlights the "strong contrast" in colors, specifically there is a significant difference in color gradation between the embroidery threads and the base fabric. Warm colors such as red and yellow are mainly used, with cool colors like green and blue added as accents, the example of figure 2 show the strong contrast of color in terms of Huangmei cross stitch craftwork.

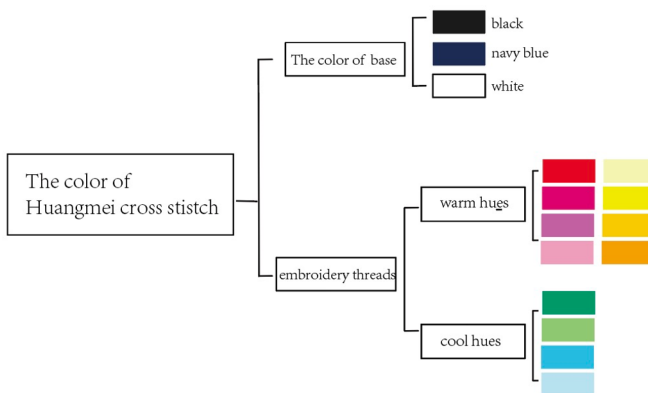


Fig. 1. The color of Huangmei cross stitch



Fig. 2. Strong contrast of color

2.3 The Current Situation of Huangmei Cross Stitch

As a national-level Intangible Cultural Heritage Huangmei cross-stitch also faces inheritance challenges in modern society, such as the shortage of inheritors for traditional craftsmanship and slow development caused by changes in market demand.

1) Talent shortage

Talent shortage is one of the key factors restricting the innovative development of Huangmei cross-stitch digital art. Zhou(2024) points out to complete the cross-stitch handcraft generally takes at least three to five days, and sometimes up to month. Therefore, the high quality cross-stitch requires creators immerse themselves into the process. At the same time, Song (2024) notes nowadays, more and more young generation have no intention to devote themselves on the traditional culture development since young creator consider that the remuneration received of artworks is often not commensurate with the effort. At the same time, in terms of the background of digital development, there is a severe shortage of professional talents who are proficient in both digital technology and the traditional culture of Huangmei cross-stitch. To be more specific, Liu (2025) presents it is a fact that digital technology developed rapidly and the number of relevant professionals is increasing, while the current situation is that most of talents are concentrated in some popular field such as the internet, games, films and high-tech industry.

There are several reasons for the situation of talent shortage, the first reason is that, the education system pay less attention to cultivate the traditional talents, since few professional programs focused on the integration of digital art and traditional culture. On the other hand, Zhao (2024) compared with high-paying industries, the field of integration digital art with traditional culture failed to provide considerable income.

2) Lack diversity method to spread

Limited marketing channels is also a crucial factor to restrict the development of Huangmei cross-stitch digital art products. Currently, the promotion of these products relies mainly on traditional offline exhibitions, cultural events, and simple online promotions, lacking diverse and innovative marketing channels. Feng (2015) argue that although online promotion offers advantages such as wide dissemination options and effective character, the promotion of Huangmei cross-stitch digital art products on online channels like social media and e-commerce platforms remains insufficient, with

a lack of effective marketing strategies and methods. While some digital art products are listed for sale on e-commerce platforms, their exposure and sales volume remain low due to the absence of professional operation and promotion teams.

3) Technical challenges

In the process of digital art innovation for Huangmei cross-stitch, a series of technical challenges have emerged (Xu, 2014). For example, data collection is one of the key challenges, since Huangmei cross-stitch works equip with complex texture, rich colors and unique cross-stitch details. However, Liu (2025) points traditional image capture equipment and technologies struggle to meet the requirements of high-precision collection. In terms of data presentation, Zhao (2024) presents although digital technology offers various possibilities for showcasing Huangmei Cross-stitch, to achieve high-quality demonstration effect is still facing challenges. Liu (2024) demonstrates that in virtual reality (VR) and reality (AR) displays, enhancing the smoothness, stability, and interactivity of the images is a key issue to be addressed. Currently, VR and AR technologies often suffer from problems such as image stuttering and delays in practical applications, which impair the audience's immersive experience. Additionally, how to combine the digital display of Huangmei Cross-stitch with traditional display methods to meet the needs of different audiences is another direction that requires further exploration.

3 The Digital Art Innovation of Huangmei Cross-stitch

Traditional cultural elements possesses high historical value, cultural value and inheritance value. Thereby, it is a rewarding attempt to combine the Huangmei cross-stitch with digital art. At the same time, the integration is not only an effective approach to achieve the innovation of traditional art and modern art, but also an important measure to spread the Chinese outstanding culture. As the handcraft creator of Chinese culture should be equipped with ability of digital media art to explore more creative method.

3.1 Digital Talents Cultivation

Fostering digital talents is one of the crucial way to develop traditional culture. liu (2025) suggests universities should be encouraged to provide majors related to the integration of digital art and traditional culture to optimize the curriculum system. For the major of digital art, more courses on traditional culture should be added to help students understand the value of traditional culture. At the same time, Wu (2025) also argues that the practical teaching also should be enhanced by cooperating with relevant enterprises to establish internship base. Therefore, students can accumulate experience and improve their practical operation ability. On the other hand, online education resources also can be used, since the some education platforms focus on the research of traditional and digital integration which enable to provide relative courses and resources for students. What's more, in terms of young generation lack the passion of traditional culture, educators can collaborate with institutions like museums and cul-

tural centers to organize joint courses and exhibitions, therefore, students awareness and respect for culture heritage will be improved.

3.2 Digital Immersive Experience

In the background of the rapid development of digital art technology, the static demonstration of traditional handcraft failed to meet people requirements for deep understanding of traditional culture. Therefore, through the digital technology enable to transform traditional culture from exhibits into participatory immersive scenarios. Xu (2024) presents that the technology of AR also could create immersive environment. Specifically, VR technology can simulate the production scenes of Huangmei cross-stitch, allowing visitors to experience the creative process of cross-stitch craftsmen in an immersive way. On the other hand, Zhao (2025) claims that VR enable to integrate virtual Huangmei cross-stitch elements with the real world by scanning specific markers or scenes with a mobile phone camera, visitors can see the presentation of virtual content such as Huangmei cross-stitch patterns and animations in the real environment.

In terms of the process to carry out the creative design, Touch Designer is one of the effective digital tools to demonstrate the motion images. Touch designer is the real-time interactive visual creative design platform. The products which are designed from Touch Designer can be widely used in different field such as media art, immersive projection, interactive installation, digital culture and creative products, visual performance. Touch Designer as one of the most mainstream real-time visual creation tools, the feature of this tool is to use nose-based and visualization-centric structure. At the same time, one of the advantage of Touch Designer is largely avoids the complexity of traditional code-based programming, enabling the creation of dynamic visual, audio-visual synchronization and real-time rendering. It has greatly reduced the technical barrier to digital innovation, providing stable and efficient technical support for intangible culture as well as. Touch Designer is also a great tool to be applied in AR and VR filed, since it has strong hardware compatibility. It seamlessly connects with various hardware devices and interactive sensors, including projectors, LED screens, AR, and VR equipment, enabling smooth external device communication. It also works reliably with Kinect motion sensors, Arduino controllers, brain-computer interfaces, and other devices.

Touch Designer consists of six types of operation, these six operation is presented in figure 3. The first operation is Top which is for texture processing, handling imported and exported visual materials. The second operation is SOP which is for 3D geometry modeling. The third operation is CHOP which is for information and data processing, managing control signals, audio and sensor data, serving as the core module for interaction and dynamics. The fourth operation is DAT which is for text, table and scripts processing. The fifth operation is MAT, the function of MAT is for material rendering, handing materials and textures of 3D objects. The last operation is COMP, this module is for modular composition and scene assembly.

These six node systems build a complete creative workflow. By dragging and connecting nodes on the interface, creators can generate graphics, control animations and

produce interactive effects. The process is highly intuitive, allowing repeated adjustment and reuse of elements, the operating interface is shown in figure 4. As a visual programming tool, TD offers distinct advantages over traditional coding software. Changes to node parameters and connections take effect in real time. All content — including images, audio, 3D models, sensor data, and scripts — is transmitted as data streams between different nodes. Each node functions as an independent data-processing module, which can be freely connected, nested, and reused. Any part of the project can be modified at any time, greatly expanding creative space and strongly supporting rapid creative iteration. When designing real-time interactive effects, TD features a built-in time-driven system. It generates time signals through modules such as CHOP, enabling zero-latency interaction with gestures, audio, sensors, and other inputs. Furthermore, TD supports cross-software compatibility, converting external data formats — including images, audio, 3D files, sensor signals, and scripts — into standardized data streams, offering creators a wide range of flexible options.

In terms of the innovation design of Huangmei stitch, table 2 presents the poster of Huangmei cross-stitch, the work based on the traditional patterns of Huangmei Cross-stitch, this innovation extracts the characteristics of classic colors and symmetry, and combination cross-stitch with the topic of four seasons to carry the design process. In terms of pattern selection, classic patterns of Huangmei Cross-stitch are adopted for creative design, while these patterns are integrated with the four seasons. At the same time, according to the creative elements design of Huangmei cross-stitch, different elements are produced into different types of dynamic particle visual effect with the software Touch Designer. Meanwhile, table 3 shows that the dynamic visual of particle effect of each pattern. TOP module in Touch designer adjust the two-dimensional work of Huangmei cross stitch. Subsequently, three-dimensional rendering and dynamic path generation of the patterns are conducted in the SOP module. The MAT module is applied to render the 3D graphics with various materials. The DAT module is utilized for dynamic script programming and data processing of the patterns. In the CHOP module, relevant audio of Huangmei Cross-stitch embroidery is imported. By adjusting the scaling and color parameters of the graphics in the TOP module, the dynamic effect of the patterns synchronized with the rhythm of the audio is realized. Touch Designer plays a vital role in the creation of digital expressions. Qiu(2025) presents When applying particle effects to patterns, it can transform static pattern images into three-dimensional visual effects. Moreover, with the use of bloom effects, the patterns generate richer visuals during their transformation, breaking the boundaries of time and space. As a prominent example, it achieves gorgeous and layered visuals while integrating traditional craftsmanship with modern digital technology, resulting in superior dynamic effects. This also makes the design more three-dimensional and conveys the development of digital innovation.

COMP	TOP	CHOP	SOP	MAT	DAT	Custom
Add	Fit	MPCDI			Photoshop In	Spectrum
Analyze	Flip	Multiply			Point File In	SSAO
Anti Alias	Function	Ncam			Point File Select	Style
Blob Track	GLSL	NDI In			Point Transform	Substance
Bloom	GLSL Multi	NDI Out			PreFilter Map	Substance Select
Blur	HSV Adjust	Noise			Projection	Subtract
Cache	HSV to RGB	Normal Map			Ramp	Switch
Cache Select	Import Select	Notch			RealSense	Syphon Spout In
Channel Mix	In	Null			Rectangle	Syphon Spout Out
CHOP to	Inside	Nvidia Background			Remap	Text
Chroma Key	Kinect	Nvidia Denoise			Render	Texture 3D
Circle	Kinect Azure	Nvidia Flex			Render Pass	Threshold
Composite	Kinect Azure Select	Nvidia Flow			Render Select	Tile
Constant	Layout	Nvidia Upcaler			RenderStream In	Time Machine
Convolve	Leap Motion	OAK Select			RenderStream Out	Touch In
Corner Pin	Lens Distort	Oculus Rift			Reorder	Touch Out
CPU+Plus	Level	OP Viewer			Resolution	Transform
Crop	Limit	OpenColorIO			RGB Key	Under
Cross	Lookup	OpenVR			RGB to HSV	Video Device In
Cube Map	Luma Blur	Optical Flow			Scalable Display	Video Device Out
Depth	Luma Level	Orbbec			Screen	Video Stream In
Difference	Math	Orbbec Select			Screen Grab	Video Stream Out
DirectX In	Mix	Output			Send	Video

Fig. 3. Six operation of Touch Designer

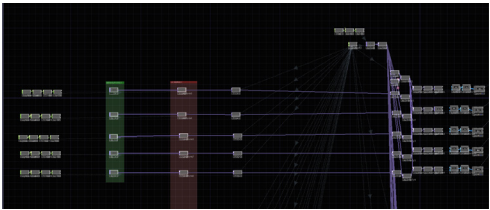


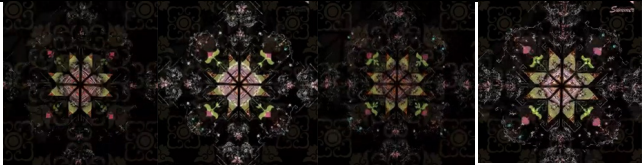
Fig. 4. The node-based visual programming system of Touch Designer

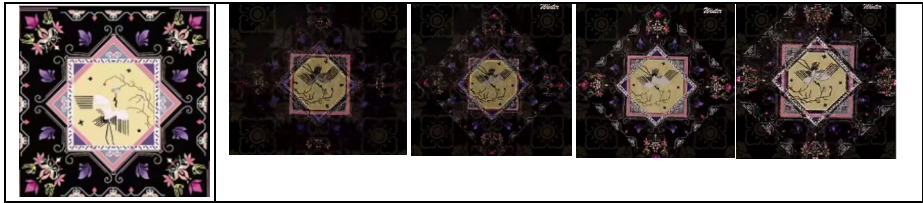
Table 2. The innovation pattern design of Huangmei cross stitch

innovation pattern design of Huangmei stitch	The pattern element design of Huangmei stitch	The poster design of Huangmei stitch



Table 3. The dynamic particle design of Huangmei stitch in the software of Touch Designer

Innovation pattern design of Huangmei stitch	Dynamic particle design of Huangmei stitch			
				
				
				



3.3 Digital IP Development

Digital IP is important way to spread and protect traditional culture. Digital IP help traditional handcraft to deliver the conventional culture attractively (Liu,2025).To be more specific, nowadays, it is hard for young generation to spend time on understanding traditional handcraft deeply. However, one of the characters of IP is information delivery effectively and easily. On the other words, digital IP makes it possible to attract attention of a large group of people quickly. In terms of the digital IP of Huangmei cross-stitch, as the example of figure 5, the character is a young generation with traditional cloth, specifically, one of the elements of IP is from the classic pattern which was extracted as the cloth decoration .What is more, the color selection for the clothe of the IP is red and yellow which are the typical color of Huangmei cross-stitch. At the same time, the main character of the digital IP is like a handcraft young creator which has close relationship with huangmei cross-stitch. Beside, in order to make IP adapt more different scenarios ,more IP stickers also can be created. In terms of the application for digital IP, IP can be printed on stationery, home decoration such as phone cases. Beside, digital IP also can be used in the embroidery museum or related culture festivals that audiences have opportunities to require the information of Huangmei cross-stitch from digital IP introduction vividly. Therefore, the digital IP can be widely used in different scenes which make it possible to spread the Huangmei cross-stitch effectively.



Fig. 5. IP of Huangmei cross-stitch by writer

3.4 Brand and Marketing

With the development of digital art, traditional culture can be spread through the way of branding and marketing. To be more specific, Feng (2025) points out that the elements of traditional culture can be integrated into the brand design and product packing. At the same time,Liu and Zhao (2025) presents during the process of brand creation, the related traditional cultural stories can be integrated into the brand marketing.As an

example of Huangmei cross-stitch, in terms of brand designing, the character of scarcity of handcraft cross-stitch, the cultural significance of pattern and the interestingness of folk life can be given priority. First is about brand Logo creation, brand Logo based on the cross-stitch with intersecting colored lines and the color will choose indigo and vermillion from the classic traditional cross-stitch. The second of brand and marketing is to development a digital brand manual to introduce the application standards of pattern, color and Logo in different scenarios. The brand visual application also contains some cultural products such as refrigerator magnets, keychains and high quality handcrafted bag with classical pattern of Huangmei cross-stitch. Figure 6 presents the culture products of Huangmei cross stitch.

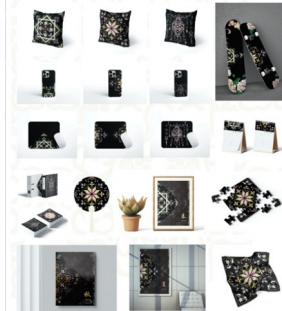


Fig. 6. The digital design and culture products of Huangmei cross-stitch by Zixuan Zhang

3.5 The Digital Resources System Construction

Intangible Cultural Heritage possess rich content and exhibition scenarios and people have explored the diversity method of traditional culture in the digital environment (Liu and Zhao 2025). At the same time, the digital art technology contribute to spread traditional culture more effectively. However, there are still many traditional culture are is the danger of dying out, one of the reasons is lack advanced approach to store the resources (Song 2024) .In the development of digital age, the construction of digital archives and knowledge provides a scientific foundation for the systematic protection of traditional culture (An 2025) .In other words, digital technology provides an entirely new method for the recording and preservation of Huangmei Cross-stitch. First, Xu (2024) points that in order to deal with the problems of traditional protection, digital archive system utilize technical method such as high-definition photography and 3D scanning to conduct comprehensive records of traditional culture. During the operation of digital protection, in the data collection phase, standardized and digital collection will be adopted to ensure the accuracy of the data collection (An 2025). Second, for knowledge base construction, the technology of cloud storage is be used to realize the resources organization with multiple formats, such as text, images and videos. For example, a graphic database for Huangmei cross-stitch can be created, which stores information on various cross-stitch pattern ,color combinations. It is convenient for users to query and use effectively. Meanwhile, Liu(2025) points that a knowledge system construction also will utilize technologies like big data and artificial intelligence to analyze the digital resources, extract core technique of traditional culture, build a

comprehensive knowledge system as well as. For instance, by analyzing the pattern and embroidery of Huangmei cross-stitch, we can summarize the information such as the culture content, artistic characteristics and the law of history evolution.

4 Conclusion

This study discuss deeply into the digital art innovation of Huangmei Cross-stitch. By analyzing the historical origin, artistic characteristics ,concept and characteristics of digital, the digital method to develop traditional culture as well as. In digita age, digital art provides new opportunities and approaches for the inheritance and development of Huangmei Cross-stitch. Through digital art innovation, Huangmei Cross-stitch can break the limitations of traditional inheritance methods, showcase its unique artistic character and cultural connotations with vivid and diverse style. On the other hand, digital art works also attract greater attention of traditional culture among the young people, bring positive effect for young generation as well as .It not only offers new method for the protection and inheritance of traditional culture but also integrate new vitality into the innovative development of traditional culture, it will contribute to a crucial power that promotes the integration of traditional culture with modern society.

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