



Research on the Innovative Design of Traditional Pattern Visual Elements under the Aesthetics of Shape Grammar*

—Taking the National Intangible Cultural Heritage Nantong Banyao Kite as an Example

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Abstract

As a national intangible cultural heritage, the survival status of Nantong kites has also changed with the times. This paper mainly uses a combination of field investigation and literature research to conduct field investigations, focusing on the artistic form of Nantong kites. Through the oral materials of the inheritors and the use of qualitative analysis methods, it comprehensively summarizes its modeling characteristics, aesthetic value and profound cultural connotations. In addition, this paper has made innovative designs for the kite surface art of kites, explored its activation methods and development mechanisms in the modern context, and proposed new ideas for dynamic development.

Subject Areas

Culture

Keywords

Kite, Folk Art, Inheritor, Kite Mask Design

1. Introduction

General Secretary Xi Jinping pointed out that we must do a good job in the systematic protection of intangible cultural heritage and promote Chinese culture to

*Note: The information in this article is derived from the oral accounts of the inheritors and field surveys, and the kite mask design was drawn by the author.

the world. China has a long history of kites, with various shapes and styles and many schools. As one of the four major kites in China, the Nantong kite has profound artistic and aesthetic value [1]. Tongzhou native Jiang Changqing wrote in his Chongchuan Bamboo Branch Poems: “There are kites as big as sails, and they are made of double butterflies and single butterflies. Their sounds are like a huqie, but they are most common near the embankment.” “As big as sails, equipped with whistles.” This is what Nantong people say about flying kites on the beach. The whistle blows in the wind to monitor the upper air flow, predict weather changes, warn of storms, and protect the safety of the area [2]. It carries people’s good wishes for peace, health, and plenty of food and clothing. On May 20, 2006, the Nantong kite was approved by the State Council to be included in the first batch of national intangible cultural heritage lists [3].

2. The Basic Shape of Nantong Kite

The Nantong Banyao kite has a unique shape. Compared with other kites, it is larger in size, flat like a board and equipped with a whistle. When it is released, the kite makes rhythmic sounds, which is very local in character.

2.1. Various Shapes of Kites

Nantong kites are based on hexagons, and form a series of star-shaped kites through combination changes. The basic styles include hexagonal kites, seven-linked stars, nine-linked kites, etc. The traditional styles popular in various parts of Nantong are different. The seven-linked star kites are mainly used in the Gangzha area of Nantong; the nine-linked kites are more common in Rugao and Rudong (See Figure 1). Today, Nantong kites have developed in an integrated manner, with little difference.

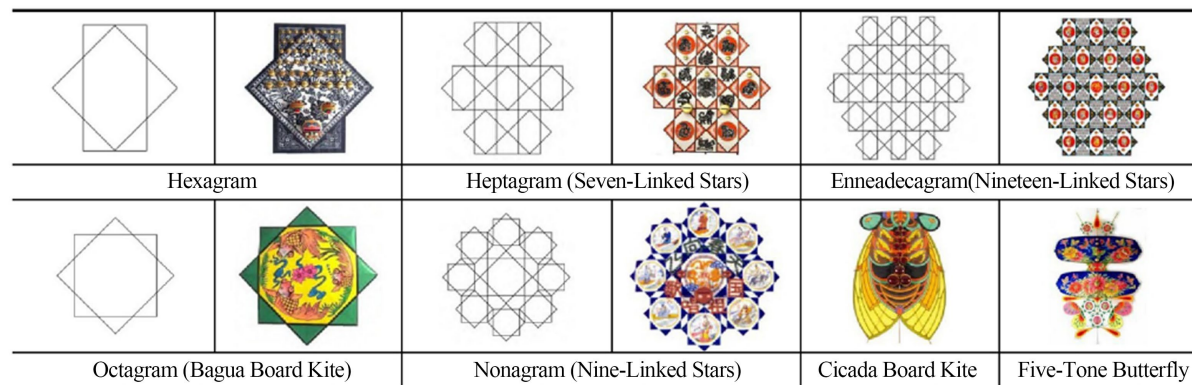


Figure 1. The basic shape of a kite [4].

2.2. Materials Used for Kite

The earliest material used in making kite faces was coal paper. Because paper was easily damaged, craftsmen pasted mosquito net cloth on the back. Nowadays, nylon cloth or silk is mostly used. Competition-level kites generally use silk. Com-

pared with nylon cloth, silk kites are easier to fly, but not conducive to long-term preservation. Therefore, nylon cloth is the first choice for kite boards.

Traditional kite frames are mostly made of bamboo and bamboo strips. As time goes by, bamboo is gradually replaced by carbon fiber tubes, which saves the steps of baking, shaping, and drying. At the same time, carbon fiber tubes are retractable and detachable, making them easier to carry than traditional bamboo tubes, and can also make more sophisticated kite frames. This is also a major innovation in the development of kite frames (See **Figure 2**).

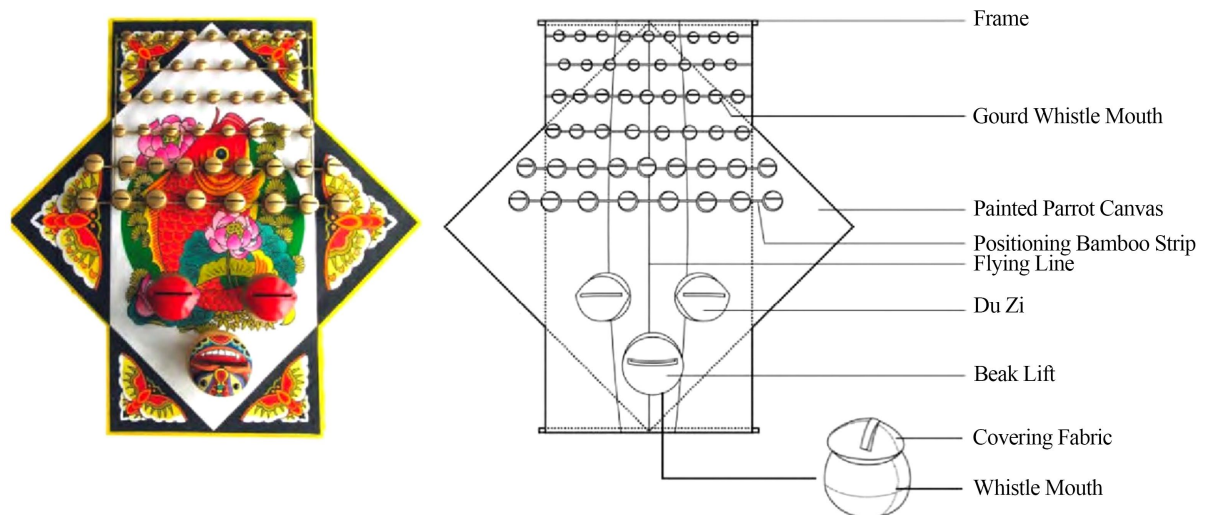


Figure 2. Structural analysis of the six-pointed star kite [4].

A kite, and the angle depends on the size of the kite. Generally, the flying angle of a 1-meter-high kite is about 90 degrees, and the length of the line is about 10 centimeters. The difference between a kite and a modeling kite is that the direction of the modeling kite is the same as the direction of the line deviation, while the kite is the opposite. When flying a kite, a tail is added, and its length is 16-20 times the height of the kite, and the weight is 1:0.7. The material is generally straw, cat-tail, etc. The two materials are twisted from different directions, and the overall thickness is relatively thick, with both stability and beauty.

2.3. Exquisite Whistle Craftsmanship

Nantong kite is also known as whistle kite. The carving of whistle mouth is the most critical part of kite craft. Whistle and mouth are two different types of sound generators, which are composed of cover and whistle body. Three or two in a group are “whistle”. Bamboo tubes made of bamboo inner membrane are pasted together, which is called joint whistle. Generally, kites in Rugao and Rudong areas of Nantong use “whistle”. Single is “mouth”, and the mouth is generally made of gourd. Kites in Gangzha area of Nantong mostly use “mouth”. The main whistle of Nantong Gangzha kite consists of a pair of “duzi” and a “buzzing” mouth. The cover of the main whistle is generally made of Nantong’s unique lotus wood, and

the shape is mostly crab shell and ruyi. The main whistle of Nantong Rugao kite generally has only a pair of “duzi”. In order to be eye-catching, the color of “whistle” is mostly reddish brown, and the “mouth” is generally black with a red cover, or painted with gold powder paint. In terms of the technological innovation of the “mouth”, experienced inheritors can plant gourds of corresponding sizes according to needs. Yao Jianqiang, the inheritor of Nantong Gangzha, started to learn to make kite whistle mouths after graduation. Because the materials were rare, Yao Jianqiang only used ping-pong balls instead of gourds in the first year, and then Yao Jianqiang began to use gourds to make real whistle mouths. With the large-scale disappearance of fields, Yao Jianqiang’s main source of materials is now the market in Liaocheng, Shandong and Cangzhou, Hebei. Yao Jianqiang believes that in the inheritance of intangible cultural heritage, it is very important to have exclusive raw materials, which is also an important criterion for measuring whether one is qualified as an inheritor. In addition, Yao Jianqiang is also good at another large gourd splicing technology, which is mainly used to make extra-large whistles (See **Figure 3**).



Figure 3. Mouth, hum, and beep (photo taken by the author in the studio of Master Yao Jianqiang).

The timbre of the kite whistle in different regions also has its own characteristics. The kites in Nantong Gangzha and Rugao areas sound loud like the sound of the wind, while those in Rudong sound like the sound of waves. The unique whistle carving technique also made the whistle in Chaoqiao Town, Rudong famous for a time. The whistle in Chaoqiao Town is divided into two factions: Wu Erhuzi and Xia Sheng. Wu Erhuzi’s whistle is loud and far-reaching, but it is not easy to preserve; while Xia Sheng’s whistle is sharp and has a strong explosive power when released from a close distance, but the transmission power is weak. Liu Jianfeng, the inheritor of Rudong kites, once worshipped Ma Jian as his master, and Master Ma Jian is the grandson of Wu Erhuzi. Even if it is a master-

apprentice inheritance, the apprentice will still retain his personal characteristics in practice, which has evolved into different whistle styles and combinations. The smallest whistle on the market has a diameter of about 1 cm, and even worse, it can only reach 5 mm, while Liu Jianfeng has broken through to a diameter of 2 mm, making the whistle more portable and exquisite. In addition to Liu Jianfeng, Yao Jianqiang from Gangzha and Yang Zhibing from Rugao are both famous for their exquisite whistle carving. At the same time, in view of the shortcomings of traditional kites, Yang Zhibing shortened the length of the kite from one meter to sixty centimeters and tried to use a plastic whistle, which can reduce the price of handmade kites and attract more kite enthusiasts to buy them (See **Figure 4** and **Figure 5**).

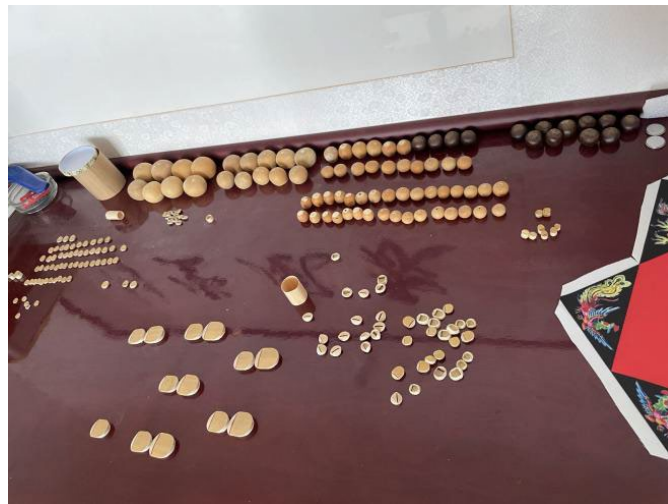


Figure 4. Whistle (photographed by the author in the studio of Master Liu Jianfeng).



Figure 5. Master Liu Jianfeng making kites in his studio.

3. The aesthetic value of Nantong Banyao Kite

3.1. Kite Art

Kite masks were mainly red stars and black corners. The earliest use of “black

corners” was pot ash, and the “red heart” was a pattern made by cutting and pasting red paper. Later, fiber pigments were used, and kite masks were mostly heavy-color fine brushwork, emphasizing smooth and natural lines and strong color contrast. It mostly expresses people’s love for the motherland and life, and reflects the beautiful mountains and rivers of the motherland, architectural art, science and technology culture, historical figures, opera stories, folk legends, and praises truth, goodness, and beauty. At the same time, it also depicts flowers, birds, fish, insects, birds and beasts. There are two main forms of pasting kite masks to the skeleton: the sound of “hole-opened” kites is farther than that of “non-hole-opened” kites, while the wind-receiving area of “non-hole-opened” kites is larger and easier to fly, and the tail of the kite also needs to increase the corresponding weight. Nantong Rugao mostly makes “hole-opened” kites, while Nantong Gangzha’s kites are mostly “hole-free” styles. Nowadays, digital printing technology is also used in Yaomian, and there are some innovations in the subject matter, such as the emergence of new themes such as anti-fraud propaganda and city business cards (See **Figure 6**).


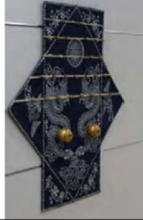




Types	Flora and Fauna	Mythological Symbolism	Folk Customs and Traditions
Monochrome Patterns			
Multicolor Patterns			

Figure 6. Classification of patterns on kites [4].

3.2. Cultural and Creative Derivatives

In order to adapt to the development of the times, the inheritors of kites in various places have also focused on modern media art, combining various artistic forms to innovate and make kites revitalized. Yang Zhibing, the inheritor of kites in Rugao, got his innovative ideas for kites from a certain exchange activity. He saw the use of computer technology to imitate silk screen printing to make kite facial makeup patterns, and then use a brush to draw the outline of the print on the kite. This method is fast and meets the requirements of hand-painting. It is an innovative method worth promoting. In terms of logo design, Yang Zhibing believes that the most important feature of icon design is simplicity and clarity, such as using the most classic hexagonal kite shape.

Younger inheritors like Liu Jianfeng have more novel ideas for the creative de-

sign of kites. He mentioned that kite mask painting can break the original stylization, combine with Chinese peasant paintings, and even collide with foreign art works, resulting in a series of creative products. Or it can evolve from traditional patterns to modern digital printing, and integrate traditional arts and crafts such as folk paper-cutting and blue printed cloth with kites.

4. The Cultural Connotation of Nantong Banyao Kite

4.1. Folk Culture

Nantong kites were once used as a tool for observing the weather and praying for peace, carrying the infinite wisdom of the Nantong people in their production and labor. Nantong's economic development began with salt production. The advantages of coastal geographical conditions have created excellent conditions for local agricultural development. Nantong kites are also widely used as a tool for weather measurement in production and labor. Flying kites, relying on the sound of the whistle and the visibility of the pattern to identify the weather and predict the wind and waves at sea, has become a necessary activity before people go out to sea. People pray for sunny days and a prosperous harvest, and kites have also become an excellent carrier for people to look forward to gods and pray for protection.

When flying a kite, people will place it in the main hall, prepare incense, candles, and auspicious paper horses to pay respect. When flying, people will choose a strong and experienced kite flyer (called "hand-held leader" in the dialect) as the leader, usually leading several young men to hold the kite and pull the string, ready to fly. When the kite flies into the sky, people cheer and jump for joy, implying that the year will be good weather and good harvest; if it falls in mid-air or falls on someone else's roof, it is unlucky, and you need to burn incense and kowtow, tear the kite into pieces and throw it on the river beach or in the cemetery. Nantong kites also mean offering to gods, warding off evil and bringing blessings. Flying kites is known as sending away "bad luck". People paint paper horses, images of gods, and whistles on kites, and then fly them into the sky. The roaring sound from the whistle is like the incarnation of "Thunder God", which can bless the world with peace and prosperity.

4.2. Inheriting History

The Gangzha kite first appeared in the area of Tanglutou, Chenqiao. Later, the kite in Jiangoutou, Zhadong, led the development of kites in the surrounding areas, which led to the current kite culture. The most representative one is the Xujia whistle in Gangzha, whose whistle skills have been passed down for five generations. It can be seen that the Gangzha area has made an indelible contribution to the development of kites. As the inheritor of the Gangzha kite, Yao Jianqiang was influenced by his ancestors and learned the kite making craft from his father (Yao Haimazi) since he was a child. The Yaojia kite has long been famous, and the whistle is loud and can be heard up to 6 kilometers away. There used to be many

people who wanted to buy the main whistle at a high price, and some people even waited overnight in Yaojiaditou to see the main whistle of the Yaojia kite.

In 1968, the survival and development of kite flying faced challenges. Affected by the social environment, most of the kite production in Nantong has stopped. Those who still insist on making kites include the Yao family, as well as Xi Hanlin, Da Wenhua, Gu Taokun, Lu Hande, Sheng Hanlin, Lu Jinglong, Yao Xilun, Shi Luhai, Wang Ruhou and others who went north. In order to protect the kite, they waded across the river and hid the kite in the area of Xingfu Street in Nantong. But due to poor storage conditions, many whistles were lost. As the environment improved, Yao Jianqiang raised funds to equip the existing kites with whistles, and kites reappeared in the public eye. However, because these kites were not kept by Yao Jianqiang at first, they went through many twists and turns such as being sold secretly and resold at high prices. Finally, thanks to Yao Jianqiang's search, these kites have been preserved to this day.

In 2006, Yao Jianqiang founded his own Chunhua Kite Studio. In line with the times, Yao Jianqiang opened his own online store on the e-commerce platform. Invited by Tangzha Ancient Town, Yao Jianqiang founded Tangzha Ancient Town Yuanshoufang Chunhua Kite. He has been committed to promoting the intangible cultural heritage of kites, and has been active in kite-making teaching in various universities, kite experience classes in primary and secondary schools, and the filming of kite documentaries, making great contributions to the inheritance and development of Gangzha kites (See **Figure 7**).



Figure 7. Demonstration of making a whistle hat by Yao Jianqiang (photographed by the author in the studio of Master Yao Jianqiang).

5. Transformation and Exploration of Nantong Banyao Kite

The Nantong Banyao market is sluggish, the number of buyers is decreasing year by year, and it faces the dilemma of being out of touch with society. Based on the importance of the inheritance and development of intangible cultural heritage, the

author starts from the aesthetics of shape grammar and conducts a series of research on unlocking, adapting, and activating the traditional patterns of Banyao kites, in order to explore a universal path of transformation for traditional intangible cultural heritage (See **Figure 8**).



Figure 8. Color extraction and analysis of a kite [4].

5.1. Creative Design Concept and Practice of Kite Surface

5.1.1. Shape Grammar Theory

The shape grammar theory was proposed by George Stiny and James Gips in 1972. It is a systematic method for morphological generation based on substitution rules. With the deepening of Stiny's subsequent research, the framework and rule system of the theory have gradually improved, forming a complete theoretical paradigm. Its core process includes three stages: initial shape selection, deduction rule execution, and new shape generation. According to the nature of the operation, the deduction rules can be divided into three categories: inheritance rules, such as copying, displacement, scaling, rotation, and mirroring, which keep the geometric characteristics of the initial shape unchanged; modification rules, such as additions, deletions, and substitutions, require local adjustments to the original shape based on subjective intervention; derivative rules, including compound operations such as circular arrays, linear arrays, and spiral arrays, further expand the diversity of morphological generation.

In the innovative design of traditional patterns, if the original pattern is used as the initial form and the inheritance rules are applied, its visual genetic characteristics can be effectively retained; and through the superposition of multiple rules, the pattern innovation path can be significantly broadened, providing methodological support for building a dynamic pattern database. At present, this theory has been widely used in the fields of architectural form generation, industrial product design and cultural and creative product development, especially in the algorithmic generation of regular and irregular graphics (such as lacquerware cloud patterns and batik floral patterns), showing significant advantages. Some researchers further combine computational modeling technology to achieve intelligent innovation in product form through quantitative analysis of deductive rules, and promote the deep integration of design theory and technical practice.

This study employs the “Tongyin” Seven-Star Board Kite and the “Tongtu” Hexagonal Board Kite as representative case studies to elucidate the application logic of shape grammar. Taking the “Tongyin” design as an example, the initial

form draws from classical motifs in Nantong blue calico, such as the “Fu Lu” gourd (symbolizing prosperity and longevity), whimsical fish patterns, and embroidered ball motifs, alongside dialect-based textual symbols. Through inheritance rules (e.g., proportional scaling and mirror-symmetrical arrangement), these motifs were systematically transformed to establish a foundational framework. Subsequently, modification rules were applied to achieve a heterogeneous integration of dialect phrases (e.g., “Tong Ren Xing” [connecting humanity] and “Bao Ping An” [ensuring safety]) with blue calico patterns. This involved replacement operations to embed textual elements into the triangular and pentagonal regions of the hexagonal framework, accentuated by a vivid color palette of red, green, and blue hues to enhance visual contrast. Finally, derivative rules—specifically linear and circumferential array operations—were implemented to generate composite patterns with rhythmic harmony. This approach preserved the fluidity of traditional “heavy-color meticulous brushwork” while foregrounding the playful cultural essence of local dialects.

In the “Tongtu” design, the initial form focused on regional symbols of Nantong, including silhouettes of Langshan Mountain, contours of Haohe River, and auspicious cloud motifs. Inheritance rules such as rotational and shearing transformations dynamically merged these natural landscapes with the geometric kite skeleton. Concurrently, modification rules abstractly simplified architectural silhouettes to align with the rigid hexagonal structure, while gradient transitions between red and green hues infused a modern aesthetic sensibility.

The integration of these rules ensured that traditional visual DNA was retained while enabling innovative adaptations. For instance, the rhythmic repetition of patterns through circumferential arrays in “Tongyin” not only reinforced cultural continuity but also introduced a contemporary cadence. Similarly, the geometric abstraction in “Tongtu” bridged historical iconography with minimalist design principles, exemplifying how shape grammar facilitates the coexistence of heritage preservation and stylistic evolution. This methodology underscores the potential of algorithmic rule-based systems to unlock the creative possibilities of intangible cultural heritage, balancing fidelity to tradition with adaptive innovation [5].

5.1.2. “Tongyin” Kite Surface Design

Main decoration: Nantong blue printed cloth pattern combined with Nantong dialect. Seven Nantong dialect words and short sentences are painted in the middle of the seven hexagonal kites, and the words and patterns are explained, which is very interesting. According to the style and color characteristics of traditional kites, uniform and symmetrical blue printed cloth patterns are painted on the triangles and pentagons around the dialect, including interesting fish patterns, gourd patterns, embroidered balls and other auspicious patterns, mainly in red, green and blue. While retaining the traditional charm, it also highlights the creative personality and characteristics (See **Figure 9**).



Figure 9. Drawing of kite patterns with dialect characteristics.

The meaning of the work: The “Tongyin” kite is named after the Chinese character “Tong” in Nantong and the Chinese character “Yin” in blue printed cloth. “Tong” refers to the kite as a unique cultural heritage of the Nantong area, and also carries the good wishes for the smooth inheritance and development of the kite. At the same time, the kite observes and listens to the wind to ensure peace in the area. It is about human nature, human feelings, and even more so, human hearts. “Yin” is taken from the blue printed cloth, which implies the characteristics of the floral pattern in the work, and also reflects the dialect elements, which is an indelible “print” of Nantong culture. The fusion and collision of the two major cultural heritages of Nantong will allow civilization to fly higher and go further (See **Figure 10**).



Figure 10. “Tongyin” kite.

5.1.3. “Zheng Road” Series of Works—“Tongtu” Kite

Main decoration: Combining Nantong’s regional scenery and iconic buildings, including Nantong Langshan Mountain and Nantong Haohe River silhouette, supplemented by auspicious patterns such as auspicious clouds, mainly in red and green.

The meaning of the work: The word “tongtu” carries the good wishes for the inheritance and development of kite flying. There is a saying in Nantong proverb that “Nantong is not connected to the south”, which is a manifestation of the isolation of Nantong in the past. Today, kite flying, as a cultural bridge to communicate with the outside world, is a major carrier of Nantong’s regional cultural pub-

licity, reflecting the humanistic characteristics of Nantong and becoming a major name card of Nantong's cultural publicity (See **Figure 11**).

Works display:

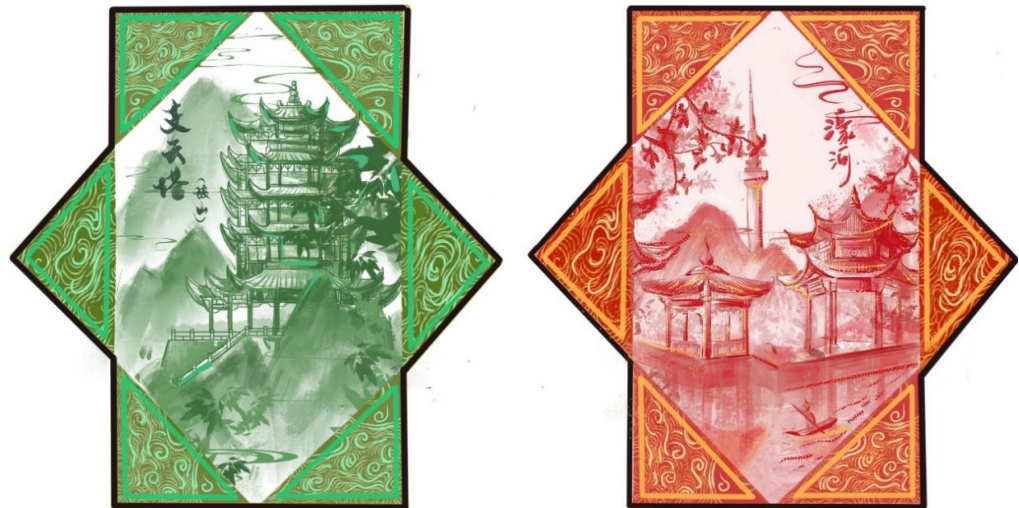


Figure 11. “Tongtu” kite.

6. Summary

Nantong kites are an important representative of local folk art. From being an indispensable tool for production and worship to today's entertainment products, the changes in their functions reflect the development of people's living habits and environment. Kites also face different inheritance and development issues in different periods. For traditional intangible cultural heritage, inheritors are undoubtedly an important way to obtain information. The study of intangible cultural heritage is inseparable from the study of “people”. Starting from the inheritors who are most closely connected with intangible cultural heritage, recording the inheritance stories, providing more platforms and opportunities for inheritors, making more inheritors known to the world, and making the stories and spirit of “guarding the art” of craftsmen traceable, this is the significance of intangible cultural heritage research.

For the study of intangible cultural heritage with regional characteristics, the influence of factors such as the development level and human geography of various places should be considered. In the process of development, it has evolved in different directions, resulting in regional differences in intangible cultural heritage. The main active areas of Nantong kites include Nantong Gangzha, Nantong Rugao, Nantong Rudong, and Nantong Pingchao Area (Tongzhou). Various regions continue to integrate and learn from each other in the process of communication. However, there are still differences in the preference for the shape of kites and the different whistles in various regions. Therefore, the influence of regional differences should not be ignored in the research process. It is worth thinking about that in recent years, a “wind tube kite” has appeared in Nantong. This

kite does not belong to the kite, but a new kite influenced by the delta wing kite in Weifang. Through technical improvements, it can be installed with more whistles than the kite, the whistle is louder, the hem width is as low as 1.8 meters, and the height can reach 18 meters. Wind tube kites appear more in the Pingchao area of Nantong. In recent years, most of the kites people fly are “wind tube kites”. There is no doubt that the harmonious development of kites and “wind tubes” in the future is a realistic issue that cannot be ignored in the development of kites in Nantong (See **Figure 12**).



Figure 12. Wind tube kite (photo courtesy of Master Yang Zhibing).

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Conflicts of Interest

The authors declare no conflicts of interest.

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