A Study on Flower Patterns of Temple Cut-and-Paste Decorations based on L-system

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Abstract

"Cut-and-paste" is an architectural skill used in traditional Chinese temples to make various decorations by pasting tiles and glass. This traditional craft has more than 400 years of history, and each piece of work has noble artistry. This kind of craftsmanship is usually shown on roofs and walls of the temple, so it is also called "Art on the Roof." Due to the time-consuming or labor-intensive production and the aging of many craftsmen, this traditional handicraft is slowly disappearing. Although the paste decoration of the temple was registered and preserved by the Taiwan government many years ago, there are very few related studies, and many works are also in a state of being damaged and difficult to repair. Therefore, this study will discuss the decorative flower patterns in the paste decoration of the temple and analyze the growth of plants with the L-System. TouchDesigner visual development platform is used to create interactive works, hoping to transform traditional handicrafts into public art so that more people realize the importance of craft preservation.

Keywords: Cut-and-Paste decoration, Temple Art, Craft, L-System, Digital simulation.

1. Introduction

"Cut-and-paste" is a craft developed to decorate the roofs and walls of temples, in which "cut" involves cutting a bowl or glass into the desired size and shape, while "paste" involves using cement as a medium to glue the cut bowl or glass to the stucco sculpture (Figure 1). To present this craft requires a high level of skill, and it usually takes several years to complete the delicate decorative works, hence the name "Art on the Roof." These works are not just temple decorations but represent the iteration of Taiwan's traditional craftsmanship and

Fig. 1 Tools and materials for Cut-and-paste

Meng-Fan Huang, Tzu-Hsien Yuan, Janaka Rajapakse

are more like a dialogue with us through time and space. Even though the inextricable link between temples, faiths, and believers, the art of Cut-and paste went into decline with the high threshold of learning and the substitution of materials by mold making, coupled with the fact that the work is often decorated high up in temples, making it invisible to the public. The less the public cares, the harder it is to understand and pass on the importance of this culture. Although Cut-and-paste originated in China, the craft almost disappeared from the country after the Cultural Revolution[1], and Taiwan concerned them as an essential cultural asset that needs to be preserved. Currently, Cut-and-paste has been approved as a tangible cultural heritage in Taiwan but faces the dilemma of not having a well-established place for people to learn it and no related courses in the academy. In today's era of rapid technological development, many contents are being digitally transformed, but few traditional crafts are digitally reproduced. In this regard, our study will bring more attention to this cultural preservation issue through practical research and analysis in a cross-media approach, using technology to bring people closer to Temple roof craftsmanship.

2. Study Background

Cut-and-paste is not the temple's main structure, but the exquisite decoration is like putting on a unique style for the temple, bringing a different impression to the people. In the early agricultural society, education was not widespread among the people, temples as centers of faith were often decorated with themes from mythological stories and novels that conveyed the spirit of loyalty and filial piety, which not only had auspicious meanings but also served the purpose of educating people. Other works have a wide range of subjects, such as the common double dragons on the roof (Figure 2), the Seven Pagodas, and the Three Immortals of Fortunate Life. The walls are often decorated with flowers and birds, such as dragons and phoenixes, flowers and trees, birds and animals, and the Eight Immortals.

In the process of learning from existing craftsmen (Figure 3), we start with the basic decorative patterns, including the cutting of petal shapes, gluing techniques, flower shapes, and the composition of growing branches. As learned from the craftsmen, the "Chrysanthemum" is a traditional Chinese flower known as the Four Gentlemen of Flowers. Because of its allusive meaning of

Fig. 2 Common Temple Roof Decoration

Fig. 3 The craftsman teaches cutting skill

Fig. 4 Cut-and-paste chrysanthemum (Left), Real chrysanthemum (Left)

"longevity," it is used in many decorations. When observing Cut-and-paste chrysanthemum works, we can see that the flowers have a bright yellow color, and the petals were made by cutting and pasting with glass and have a slightly inclined angle. There are five to six layers,

which slowly close together with the center. Although the shape of the petals of the cut-and-paste chrysanthemum has been altered to present them at a sharp angle, the reference form of this cut-and-paste work is a pom-pom type of chrysanthemum according to the above observation (Figure 4).

3. Digitalization

The preliminary phase of this research analyzed the most basic flower forms, including the expected selection of chrysanthemums and peonies (Figure 5) as the theme. The petals and leaves of the selected flower forms were simulated using mathematical procedural functions.

4. L-System

Lindenmayer system (L-System)[2] is a mathematical model of cellular interactions in growth and development. Because of the high similarity of plant models, it is easy to be defined, and such a rule can develop the growth structure of plants by increasing the number of layers of the L-System progression. For example, the plant-like structure generated by L-System (Figure 6) is defined by following Eq. (1).

In computer graphics and interactive content generation, L-System is widely used[3]. In the visualization software TouchDesigner[4], we tried to write different expressions of leaves and petals using the L-system, followed by fine-tuning the parameters to achieve more subtle changes.

$$n=5, \delta=22.5°$$
$$X$$
$$X{\rightarrow}F\text{-}[[X]+X]+F[+FX]\text{-}X \qquad (1)$$
$$F{\rightarrow}FF$$

4.1. *Flower structures*

According to the peonies in the Cut-and-paste, many orange and red glasses are used to present the multi-layered petals. In the digitization process, the corresponding gradation of colors is used to reproduce the work, as shown in Figure 7.

4.2. *Plant structures*

Trees are often combined with floral patterns in temple decoration, and tree patterns can be simulated in L-System syntax. As Shown in Figure 8, the tree-like structures generated by L-System are defined by following Eq. (2).
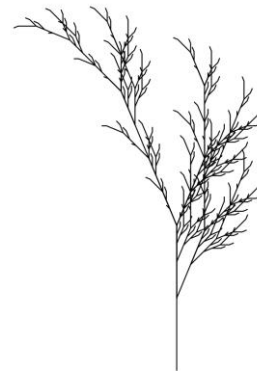

Fig. 5 Cut-and-paste peonies

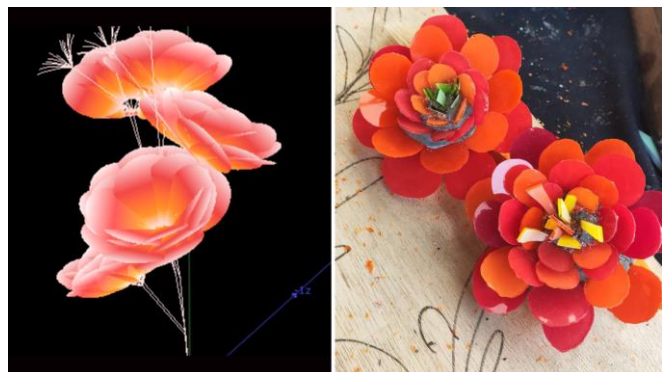Fig.6 Plant-like structures generated by L-System [3]

Fig. 7 Results of the peonies digitization

$$\text{context\_ignore: F+-}$$
$$\text{premise: A}$$
$$A=";T\sim(4) \text{ F-}[[A]+AJ]+F[\text{-FA}]+AJ \qquad (2)$$
$$F=\sim(3)!FF$$

Meng-Fan Huang, Tzu-Hsien Yuan, Janaka Rajapakse

4.3. *TouchDesigner*

Based on Cut-and-paste patterns and shapes of natural plants, the structures of flowers and plants were defined in the initial phase(Figure 9). Through the use of iteration, the L-system Surface Operator(SOP) of TouchDesigner allowed defining complex shapes of flower petals and tree structures. In the L-system SOP, an initial string of characters is evaluated repeatedly, and the generated geometry shapes were modified with Geometric nodes with instancing.
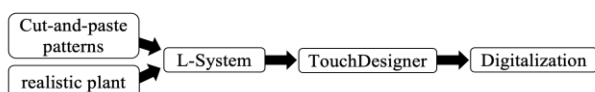

Fig. 8 Simulation of trees with L-system

Fig.9 Digitization process through TouchDesigner

5. Conclusion

This study examined the decoration of Cut-and-Paste crafts in traditional Chinese temples. In conclusion, the observations indicated that natural landscapes and realistic plant growth patterns such as flower distribution, flower shapes, and branches were related to the mathematical representation of the cell interaction of visible growth and development. The current research is a preliminary analysis of the craft patterns to ensure they can be integrated with the L-system. In the future, the results of these findings will be transformed into public art to promote traditional handicrafts in a cross-media format.

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