A generative framework for the development of creative cultural industries for western China

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Abstract

Based on the previous work by the Design Technology Research Centre in the School of Design of the Hong Kong polytechnic University, we have developed a new generative design framework for the development of creative cultural industries for western China as a collaborative initiative among the Hong Kong Polytechnic University, Xian Jiaotong University, Xian Tongli International college, Cultural Bureau of Chen Cang District, and Research Centre on Qin Opera Branches. The proposed generative framework is built on an **Rtttl** model for generative and creative product design. The terminology of **Rtttl** defines a generative process consisting of **R**esearch, **t**ranslation, **t**ransform, **t**ranscending and **I**nnovation. It extends the scope of a normal generative system in which a large number of design and its alternatives are generated by programs such as genetic algorithms or other transformational computation. Our **Rtttl** model integrates Research, Generative Design, and Innovation (Making) by linking cognitive and symbolic research of cultural genes, through a generative design process of translation, transform and transcending, with innovation through direct 3D printing as the final means of making. In particular, the generative process involves three inference engines of translation, transform, and transcending, with which creative and stylish design solutions are generated from the cultural genes of tangible products derived from handicrafts or cultural heritages. In this way, there is a sense of expansion of normal generative computation into social, cultural and historic development of design intelligence and design aesthetics. In the meantime, the three generative engines of translation, transform and transcending go beyond mere geometric, spatial or functional calculations. Instead, it relies on flexible integration of a variety of software systems including 3D solid modelling

systems to generate new design solutions that can be evaluated with multiple and cultural related criteria, and more importantly, that can be 3D printed directly. Therefore, it is possible with this framework to develop an integrated generative design system that supports the emerging creative cultural industries for western China, where the cultural and design heritages are rich and diverse, with great opportunities for design collaborations under a generative approach.

In this paper, we present several examples of using the **Rtttl** model to support generative design based on cultural heritages in Xian and Shaanxi province in western China. The purpose is to show how the three generative design inference engines of translation, transform and transcending can work with traditional sculpture and wood face painting techniques that have several thousands of years of history of development and evolution by hands, Another example is to show how the same generative model of **Rtttl** and its underline thinking can be applied to music, with Qin opera music pieces as the genes for the composition of generative music that can be played by both western and Chinese violins. This paper is accompanied by an exhibition and a live performance in the Generative Art Conference 2014 in Rome.

1. A Framework for Generative Design

Generative art and design has great potentials for creative cultures in western China. In the past, we have developed generative systems [1], [8], for product design and interactive music using evolutionary algorithms and computational transformation methods. These approaches opened many opportunities for research and development of generative design systems [3]. However, there is a need for scaling up generative systems to real industrial and product design areas amid the emergence of 3D printing techniques. It is possible now to develop a new framework of design and making integrating generative design and 3D printing, as shown in Figure 1.
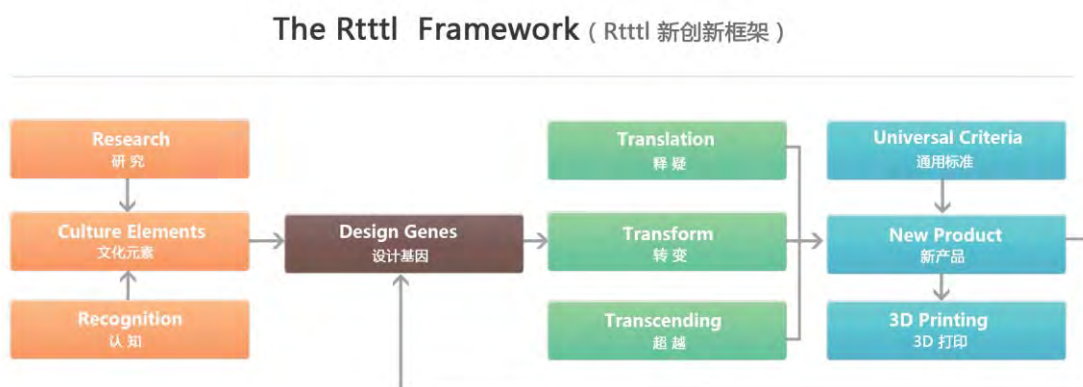

Figure 1: The Rtttl framework of generative design for creative culture industries in western China

The Rtttl framework of generative design has three main parts. These are, Research,

generative design inference engines, 3D printing and evaluation. The research focuses on how to recognize the values of cultural elements and convert these cultural elements into the genes of design. The genes of design include form, color, texture, and composition of products or objects that can be processed by the generative design engines as the input.

The generative design engines perform the tasks represented by 3 "t", that is, translation, transform, and transcending. The task of translation involves converting local and regional meanings of design genes into universal forms of aesthetic and functional substance of a new design concept. The task of transform is concerned with making changes and variations by computational methods in order to increase the populations of an original design gene. There are a wide range of choices for AI based computational techniques to perform such a generative act. But it is also possible to combine human interaction into this process. In most cases, such a generative act can be taken over by human artists or designers. The third task of transcending is the ultimate objective of generative art and design. That is, it must go beyond normal geometric or spatial transformations, in order to create new styles or new forms of innovation. This transcendence involves a sense of collective intelligence, by mixing several design genes in order to generate a collaborative creation or process. In this way, it can be said that new designs have transcended the original ones, such as the handicrafts, which are normally created by individuals.

The new generative design and making process needs to work with universal design evaluation criteria and be implemented by direct 3D printing, in order to demonstrate the advantages of generative art and design for real scale design problems [4], [7].

2. Applications of Rtttl framework with Shaanxi art and crafts

There are many outstanding cultural heritages and talented handicraftsmen/women in Shaanxi, a northwestern province in China. There is a natural link between cultural heritage and any new form of art and design technique. Generative Art and Design involves computational transformations of original design elements into their variations and complex combinations. Such a technique needs a strong connection with traditional art works and handicrafts in order to achieve the qualities that have demonstrated the powers of human brains and hands over a long history [2]. Lacking of cultural and historic significance in any computational art and design approach would only generate designs and art works that create only problems instead of solutions for our planet.

The examples we used to test the **Rtttl** model are the brilliant works done by the masters from Shaanxi, a northwest province of China [6]. They include *wood works*, *face painting*, *clay sculpture, paper cuts, patchworks,* and *shadow puppets*. They form a great series of original and cultural genes for generative art and design, with which we are developing generative design inference engines. These generative design inference engines can translate, transform and transcend the design thinking behind the tangible objects into higher level of creative works, to be supported by the

emerging 3D printing techniques for revolutionizing the process of design and making of the future. Figure 2 is an example of translating and transforming an ancient horse bowl into a table lamp. Figure 3 is an example involving a combination of generative act (translation, transform, and transcending) that requires collaboration and integration; Figure 4 is a 3D printable outcome of our **Rtttl** model in which more cultural characters are introduced into generative design process.

Figure 2: Translate and Transform an ancient horse bowl to a table lamp
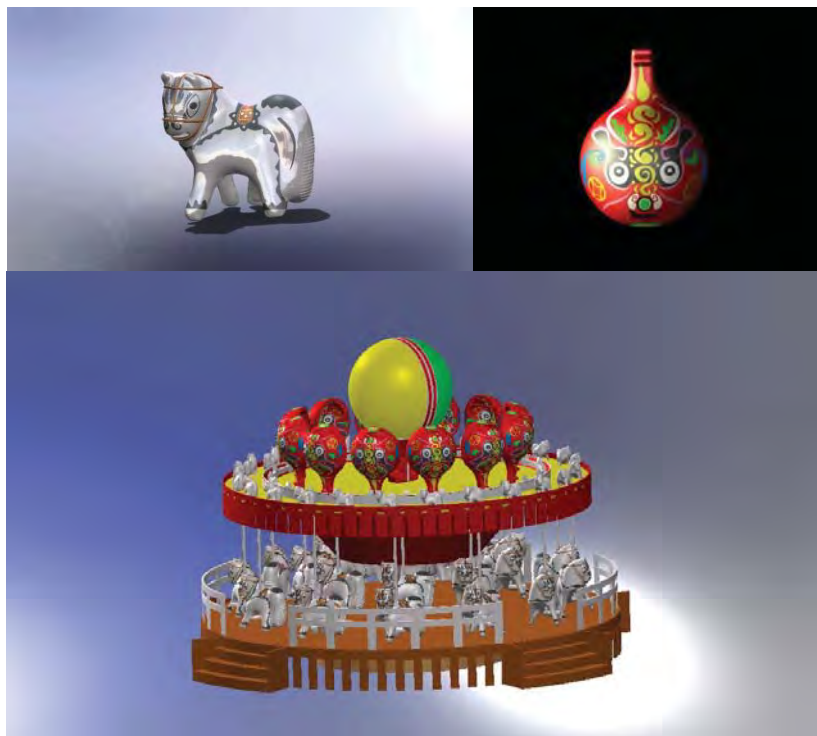

Figure 3: Translating, transforming and transcending the original design genes into products that require collaboration within the generative design and making framework

Figure 4: Many variations of designs can be generated and 3D printed with generative design framework combining cultural elements and design genes.

3. Generative Music with Qin Opera

There have been many works on generative music [5] in generative art conferences over the years. Previously we have also used generative techniques to develop interactive dance music [9]. The above discussed framework of **Rtttl** can also be applied to music. In our research, we used Qin opera as the example in our exploration.

Qin opera has some 2000 years of origination, development, and evolution. With its current form, it can be regarded as a Chinese opera with a large audience and funs only second to Peking Opera. There are many famous branches of Qin Opera. Li Shufang represents one of the best such branches (known as Xiao branch), as a leading Qin opera soprano in Xian, who has won a national award named the Plum Performance Award for Chinese Operas. In 2014, she established the Research Centre on Qin Opera Branches with the support of Professor Zhong Ming Shan of Xian Jiaotong University. The performance she gives in Rome as part of Generative Art Conference 2014 is the first of its kind on world stage. This is closely related to our research on generative music with Qin opera [6].

Qin opera music is ideal for testing our generative design framework for creative culture industries in western China. The typical characters of Qin Opera good for generative music can be highlighted as follows:

1. There are two main themes (bitter or sad theme and happy theme) which can be used as the control of emotion in generative music;
2. Many pieces of Qin Opera music have been generalized, and can be used in combination with contextual variations;
3. Such pieces have the computational conveniences. That is, they are

repetitively (with slight variations), and recursively combined;

4. The composition methods for Qin opera music can be generalized as rules that are highly associated with the stories of the opera;

5. The singers can make random or regular changes without dramatically getting away from the melodies. That is, it is always possible to leave small rooms for the singers to improvise or for the computers to change;

Figure 5: A performance of generative music with Qin opera music theme in the School of Design of the Hong Kong Polytechnic University, in May. 2014

Because of these characters, plus others features in the vocal and performance areas, there have been many different branches of Qin opera in Shaanxi, Gansu and Shanxi province where Qin opera has been popular for over 1000 years with tens of millions of funs in the vast countries.

In our exploration of generative music with Qin opera, a combination of Chinese Violin and western Violin is used, particularly intended for the live performance at the 2014 generative art conference in Rome. Such a combination is also intended to show how these two music instruments from different cultures can work together to perform and explore generative music derived from the music themes of Qin opera.

At Generative Art 2014, we came as a big group from Shaanxi province in order to introduce Qin Opera and our initial exploration of generative music with Qin opera with both Chinese and western violins.

Figure 6: Yaozhou Ceramic works have great potential for generative design and 3D printing which is our next project of this research team.

4. Conclusions

We have presented a generative framework for the development of creative cultural industries for western China with initial examples in product design developed with this framework. We have also discussed our exploration of the same framework with Qin opera. Our main conclusion is that with the emergence of 3D printing techniques, it is possible now to scale up generative art and design to embrace a new design and making process in which generative art and design is to take a leading role. In the meantime, it is possible to employ generative art approach to revive culture based designs which are traditionally only possible with hand making. Automatic generation of products using techniques such as generative art and design needs a balance and a bench mark with the sophistication and quality level that have been proved over several thousand years' history of Chinese culture. It is an opportunity as well as a challenge to further develop the framework proposed in this paper. Our future and immediate work is to develop more products with 2D inspirations but with 3D outcomes such as the one shown in Figure 6, with fully 3D printable outcomes of generative variations and innovations.

5. Acknowledgements

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