An Interactive System for Original Necklace Design

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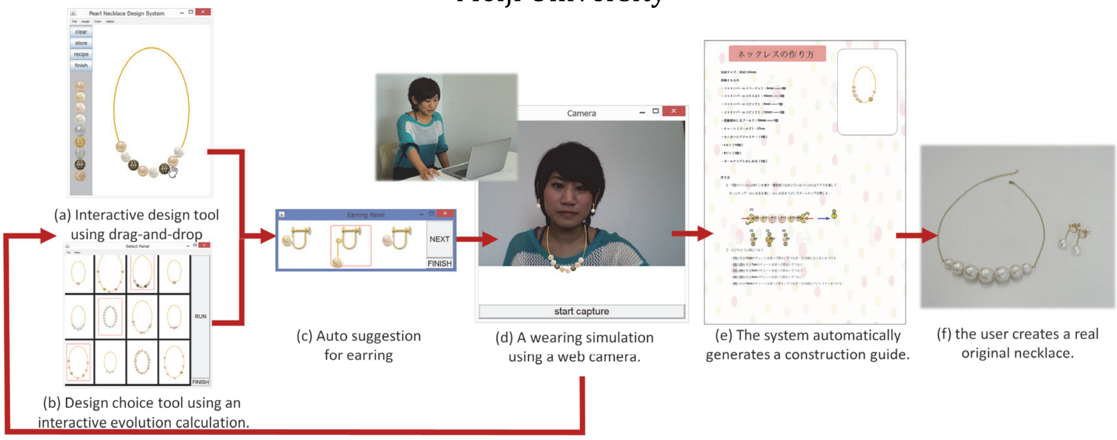

Figure 1: *System Overview.*

Abstract

We propose an interactive system to assist novices in the design and construction of original necklaces. The system consists of two design tools, an interactive drag-and-drop design tool using images of pearls and a design selection tool with an interactive evolutionary computation (IEC) system. The system includes a virtual modeling simulation which allows users to superimpose a necklace design over their own photograph, taken with a web camera. The system also provides a customized construction guide to assist the user with the construction process. We conduct a field trial to demonstrate that non-professional users can design original necklaces using our system.

Keywords: interactive design, construction guide, fabrication
Concepts: ･Computing methodologies→Computer Graphics; Human-centered computing→Interaction techniques;

1 Introduction

Making original necklaces is a popular, traditional handicraft, and many professionals design their own original work. On the other hand, novices usually follow an off-the-shelf design or buy necklace kits because it can be difficult for novices to visualize and design their own necklaces successfully without assistance.

To address this problem, we have developed an interactive system to assist novices to design and construct original necklaces. There are many possible materials which can be used to make necklaces, but our prototype system is limited to one material, known as "cotton pearl beads". Cotton pearl beads are an imitation pearl material which is made by encasing compressed cotton with a pearl coating. This material has become very popular recently because it is cheaper, lighter and easier to work than natural pearls.

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2 System Overview

Figure 1 shows the overall design system process. There are two ways the proposed system can be used to design an original necklace. The user can use an interactive drag-and-drop design tool using images of "pearls" (Fig. 1(a)) and design the necklace by manipulating the pearl images through trial-and-error on the screen. The user has the option of creating a symmetrical design by using the "symmetry design mode". The second method, the user can use a design choice tool with an interactive evolutionary computation (IEC) system (Fig. 1(b)). Since most novices need assistance in creating designs, we decided to focus on the second method, which uses IEC. The system shows the user images of necklaces which have been designed by other users using the interactive design tool. After the user chooses three preferred necklace images, the system creates next generation options for the user.

After the user has created a design for their necklace using these tools, the system proposes multiple complimentary earring designs (Fig. 1(c)). The system also includes a virtual modeling simulation, allowing users to superimpose their designed necklace and selected earrings on their own photograph using a web camera (Fig. 1(d)). If the results are not satisfactory, the user can return to the beginning and create a new design. This closed-loop framework allows users to experiment with various necklace patterns before actually producing a real necklace in order to obtain the best possible results.

Finally, the system also provides the user with a construction guide to assist them with the manual construction process (Fig. 1(e)). The user can then actually produce their original necklace using the guide (Fig. 1(f)).

3 Implementation

3.1 Design using IEC

IEC is a technique for optimizing the operation of automated systems by supplementing them with human input in the form of subjective evaluation. It also allows optimal design of complex, nonlinear systems. IEC has been applied in several fields of artistic design, such as 3D-CG lighting design [Aoki and Takagi 1997], montage face image generation [Caldwell and Johnston 1991] and office layout [Nakajima *et al.* 2006]. In this study, we use a genetic algorithm (GA) for our evolutionary genetic algorithm. This allows the system to present proposals based on the subjective evaluation and preferences of the user, who has selected which images the next generation of designs will be based upon.

The system automatically generates necklace designs using the following four criteria; 1) necklace length, 2) color, and 3) component information. The system stores an image of each necklace design created. The system then calculates the entropy [Lee *et al.* 2015; Hiyama *et al.* 2015] of a design, which in this case represents the subjective value of "luxury". Entropy H is calculated using the following equation:

$$H = \sum_{y=0}^{256} p(y) \log \frac{1}{p(y)}$$

The probability of image luminance value y is set to $p(y)$. If luminance y is an integer value from 0 to 255, the background pixels are set to $y = 256$.

The IEC based-system shows the user nine next-generation versions of the three user-selected designs, based on the entropy values of the possible images, which are calculated using the equation. The first three figures displayed are the three images selected by the user, followed by three figures modified using different colors selected by the user, in descending order of entropy. The system also displays three versions of the design with different necklace lengths, also in high-entropy order, and the remaining three designs displayed by the system are mutations of these generated designs.

3.2 Virtual modeling

Our system allows users to view images of themselves with virtual representations of necklace designs. As shown in Figure 2(a), the user clicks on two points on either side of their neck as shown in the image, at points v_{n0} and v_{n1}, and on two earring positions, points v_{e0} and v_{e1}. When the user selects the "wearing" option, the system generates a circle stroke (S_{neck}) centered on point v_c, which is the midpoint between v_{n0} and v_{n1}, with a diameter of the distance between v_{n0} to v_{n1}. This circle represents a virtual neck, around which the system then draws the designed necklace stroke $S_{necklace}$. We use 29.8 cm for the perimeter of the neck, which is the average neck size of Japanese women.

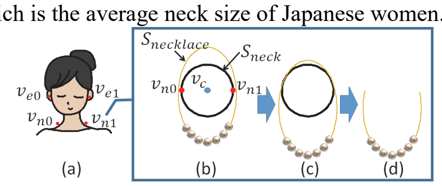

Figure 2: *Diagram of virtual modeling simulation process.*

The system then applies relaxation to $S_{necklace}$ using a mass-spring model, so as to not embed the virtual necklace in S_{neck}, while also providing simulated gravity and collision detection (Fig. 2(c)). The distance from position v_c is used for collision detection. After convergence, the system only draws the lower portion of $S_{necklace}$, from v_{n0} to v_{n1} (Fig. 2(d)). The system also draws earrings to scale using positions v_{e0} and v_{e1} input by the user.

4 Results

Our prototype system operates in real time on a laptop PC (2.4 GHz CPU, 8 GB RAM) using Java™. It takes approximately 3.4 to 3.7 seconds for the system to calculate next-generation designs using interactive evolutionary computation.

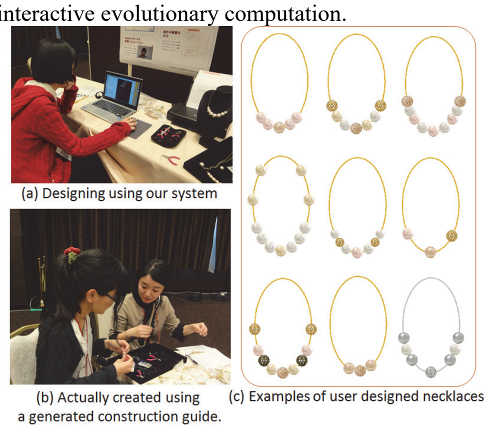

Figure 3: *Workshop for novices using our system.*

Figure 4: *Examples of actual necklaces created by users.*

We organized a small workshop for novice users (Fig. 3 and Fig. 4), at which 21 users (2 men, 19 women) designed necklaces using the system. The participants gave us valuable feedback for future improvements.

5 Conclusion and Future Work

We proposed an interactive system to assist novice users in the design and construction of original necklaces. Overall, users found the system helpful and easy to use. In the future, we would like to explore other IEC metrics which will make it easier for designers to create the necklaces they envision. We also plan to further develop the construction guide to make it easier to use.

References

AOKI K. AND TAKAGI H. 1997. 3-D CG Lighting with an Interactive GA. In *Proc. of* KES97, 296-301.

CALDWELL C. AND JOHNSTON V.S. 1991. Tracking a Criminal suspect through "face-space" with a genetic algorithm. In *Proc. of* ICGA 91, 416-421.

NAKAJIMA T. et al. 2006. Office Layout Support System using Interactive Genetic Algorithm. In *Proc. of* CEC 2006, 56-63.

LEE, N. et al. 2015. Product Value: Modeling the Relationship between "High-class Feeling" and a Product's Physical Parameters. International Convention of Psychological Science (ICPS) Program Book, V-031.

HIYAMA T. et al. 2015. Design System for 3D Objects using Interactive Evolutionary Computing: Introduction of Quantitative Evaluation of Kansei. In *Proc. of* IEICE Society Conference 2015 A-20-10 (in Japanese).