SUGISAKA MASANORI

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Research Article

Hula Accessories Design for Prototype Software

Satoshi Ikeda[1], Takumi Nakahara[2], Amane Takei[1], Kenji Aoki[1], Makoto Sakamoto[1], Tsutomu Ito[3], Takao Ito[4]
[1]*Faculty of Engineering, University of Miyazaki, Japan*
[2]*Graduate School of Engineering, University of Miyazaki, Japan*
[3]*National Institute of Technology, Ube College, Japan*
[4]*Graduate School of Engineering, Hiroshima University, Japan*

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ABSTRACT

There are two main types of hula: classical hula ``kahiko" and modern hula ``auana." Music, costumes, and accessories are essential to hula. Auana, in particular, is a dance set to music played with Western instruments and can express various aspects of mythology, history, and Hawaiian culture. The costumes and accessories worn by the dancers are designed to match the music. We thought that if we could freely design costumes and accessories on a computer and simulate the finished product, we would be able to create a design that was more in line with the dancer's image. This research focused on ornaments and developed a new CAD system as a result of basic research to develop a CAD system for designing "lei", one of these ornaments.

1. Introduction

Hula (Hulf you can freely design costumes and accessories to i match the music your computer and simulate the finished product, you can create designs that better match the image of hula. n this research, we focused on ornaments and aimed to develop a CAD system for designing one of these ornaments, the lei. As a result of basic research, we developed a new CAD system [1].

1.1. *About Leis*

Leis are accessories worn around the head, neck, and shoulders, and are thought to have been introduced by Polynesians around the 12th century. Leis have been used since ancient times to ward off evil, as offerings, and as symbols of social status, and evolved greatly around the 19th century through the use of plants brought by travelers and immigrants. The materials used to make leis include nuts, leaves, flowers, shells, bird feathers, and animal bones, with many variations shown in Fig. 1, [2].

Fig. 1 Accessory Materials

1.2. *Research Background*

Leis are made of colorful materials such as flowers, leaves, nuts, shells, bird feathers, and animal bones. In order to create a lei that meets the wishes of a hula dancer with colorful flowers and colored nuts and variations of examples, it is necessary to make the image of the finished product easier to understand.

Corresponding author E-mail: saka2000@cc.miyazaki-u.ac.jp.

Therefore, we decided to create a design program using 3DCG so that the lei designed by the user would be closer to the actual finished lei.

1.3. *Research Objectives*

This time, several functions have been added, taking advantage of our previous research. These functions are "length adjustment," "display of number of pieces," and "real-time display of designed ray. In the 3D simulation, the size of each part is randomly generated to achieve a more realistic design, and the size of each part is displayed as an ellipse to help the user have an image of attaching the part.

1.4. *Development Environment*

The development environment for this program is as follows

PC: Windows 10 Pro
Intel(R) Core(TM) i7-7700 CPU @ 3.60GHz
16.0 GB
Software: Unity 2020.3.18f1
Blender 2.92.0
Microsoft Visual Studio
Language: C#

2. 3DCG Design Program

This time, we created a program that allows users to select the "parts to be used" and "length" of the ray they wish to create (in the case of kukui, they select the color and the number of types to be used), display the results of the design in 3DCG, and view the designed ray in real time from various directions by changing the viewpoint by moving the mouse cursor on the 3D screen while clicking.

2.1. *Ray Length*

There are three types of leis: lei ai (necklace), lei po'o (headwear), and kuupe'e (wristwear). In past studies, lei eye was set to be 80 cm long for kukui, 100 cm for flowers and foliage, and 76 cm for shells; lei po'o was set to be 80 cm long for kukui, 63 cm for flowers and foliage, and 20 cm for all kuupe'e lengths.

In this study, however, the lengths were extended to allow users to design more freely by keyboard input.

2.2. *Selecting a Part Type*

Six types of lei parts were prepared: "Kukui (white, red, black)," "Denfale (red)," "Maile," and "Shell.

The respondents choose which parts to select from the four types: "Kukui," "Denfale," "Maile," and "Shell."

If kukui is selected, you can choose from 1 to 3 how many types of kukui to use shown in Fig. 2.

2.3. *Design Display*

By splitting the part selection screen and the display screen 1:1, the results can be viewed simultaneously with the input shown in Fig. 3. The number of parts used is also displayed.

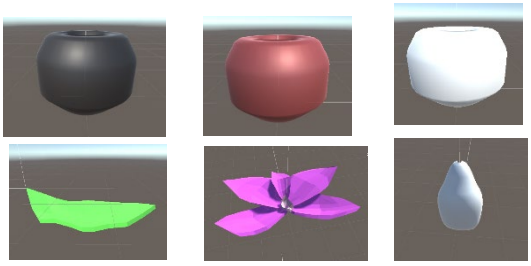

Fig. 2 Types of Parts

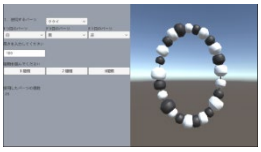

Fig. 3 Design Indication

2.4. *Randomness of Parts*

The actual kukui, leaves, and flowers are unique in size. Since kukui are between 4 cm and 7 cm in diameter, they were randomly generated at 4 cm~7 cm when designed.

2.5. *Lay Parts in an Ellipse*

A: Ratio of ellipses = b/a
a (short diameter):b (long diameter) = 2:3
L: Length of string entered by user
V: Size of the part = 4
D:Length of short diameter
It:Number of parts
R:Number of cycles = 1
Rat:Location of cycles
C:Period = 2\pi

1. Find the length D of the short radius (1)

$$D = \sqrt{\frac{L^2}{4} \times \frac{1}{4 - 8A + 4A^2 + \pi^2 A}} \quad (1)$$

2. E is determined by the following equation (2)

$$E = \frac{D}{2 * V} \quad (2)$$

3. Find the number of parts It (3) The shell is small and has twice as many parts.

$$It = \frac{L}{V} \quad (3)$$

4. Set i=0 and repeat the following from i to It
5. Generate randomly from 4 cm to 7 cm
6. Find the position Rat of the cycle (4)

$$Rat = \frac{i}{It} \quad (4)$$

7. Determine the position (X,Y) to place the part (5)(6)

$$X = a \times Cos\left(Rat \times C \times \frac{R}{2\pi}\right) \times E \quad (5)$$

$$Y = b \times Sin\left(Rat \times C \times \frac{R}{2\pi}\right) \times E \quad (6)$$

8. Rotate the part along the center of the circle.

3. Execution Result

Fig. 4 show some of the results of this program. The size, orientation, etc. can be adjusted in each case.

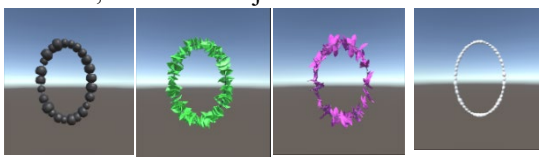

Fig. 4 Execution results

4. Consideration

This research was extended to a 3DCG design program using Unity, which resulted in an easier-to-operate interface design and improved multi-platform scalability. Additionally, new functions have been added: ``length adjustment," ``piece count display," ``real-time display of design rays," and ``randomization of material size."

Regarding the types of parts, since many are used as materials for lei, it is necessary to expand the types and colors of parts. When displaying the design, the parts are arranged in an oval shape to make it easier to imagine a lei. However, because the sizes of the parts change randomly, gaps may sometimes occur between the parts. To prevent such gaps, it was necessary to be able to simulate the appropriate number of parts and their positions in response to random changes in size.

By creating a 3DCG design program, we were able to identify various issues for the practical application of a 3DCG design program for hula necklaces (lei) in the future.

5. Conclusion

In this research, we developed a new prototype CAD system for light beam design by creating parts using Blender and 3DCG simulation using Unity. We were able to identify various issues for practical application. In the future, I would like to research various aspects, such as wearing a lei on a hula dancer and asking them to create a 3DCG image of the finished product.

References

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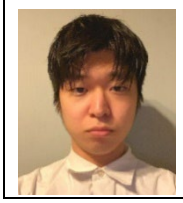
2. Hawaii Tourism Authority [Online]. https://www.gohawaii.jp/

Authors Introduction

Dr. Satoshi Ikeda

He received PhD degree from Hiroshima University. He is an associate professor in the Faculty of Engineering, University of Miyazaki. His research interest includes graph theory, probabilistic algorithm, fractal geometry and measure theory.

Mr. Takumi Nakahara



He is a master student at Department of Computer Science and System Engineering, University of Miyazaki. His current research interests include computer graphics and VR technology.

Dr. Amane Takei

He is working as a professor for Department of Electrical and systems Engineering, University of Miyazaki, Japan. His research interest includes high performance computing for computational electromagnetism, iterative methods for the solution of sparse linear systems, etc. He is a member of IEEE, an expert advisor of IEICE, a delegate of IEEJ, a director of JSST.

Dr. Kenji Aoki

He received Ph.D. of Engineering from Kagoshima University in 2010. He is currently working in Information Technology Center at University of Miyazaki as Associate Professor, since 2010. His research interests include bio-informatics, evolutionary computation, information system and Intelligent systems. He is a member of IPSJ and JSET.

Dr. Makoto Sakamoto

He received the Ph.D. degree in computer science and systems engineering from Yamaguchi University. He is presently a professor in the Faculty of Engineering, University of Miyazaki. He is a theoretical computer scientist, and his current main research interests are automata theory, languages and computation, etc.

Dr. Tsutomu Ito

He is an associate professor in department of business Administration, Ube National college of technology. His current research interests include internet of things (IoT), mechanical engineering, artificial intelligence (AI), etc. He earned his Doctor degree of Engineering from Hiroshima University, Japan in 2018.

Dr. Takao Ito

He is a professor of Management of Technology (MOT) in Graduate School of Engineering at Hiroshima University. He is serving concurrently as Professor of Harbin Institute of Technology (Weihai) China. His current research interests include automata theory, artificial intelligence, systems control, etc.