

# Prototype Software for Designing Hula Accessories

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## Abstract

Today, there are two main types of hula: the classical hula "kahiko" and the modern hula "auana". Music, costumes, and accessories are essential to these hula. Auana, in particular, is danced to music played on Western instruments and expresses the mythology, history, and various aspects of Hawaiian culture. The costumes and accessories worn by the dancers are designed to match the music. Therefore, we thought that it would be possible to design costumes and accessories more in line with the image of the dancers if we could freely design them using a personal computer and simulate how they would look when finished. In this study, we focused on accessories and conducted basic research to develop a CAD system for the design of "leis," one of the accessories.

*Keywords:* hula, Accessories, 3Dmodel, Software

## 1. Introduction

Today, hula (hula in Hawaiian) can be broadly divided into two types: classical hula "kahiko" and modern hula "auana," both of which have been passed down through generations as traditional Hawaiian dances. The music, costumes, and accessories are essential to these hula. Therefore, we thought that if we could freely design costumes and accessories to match the music using a computer and simulate the finished product, we would be able to create a design that better matches the image of

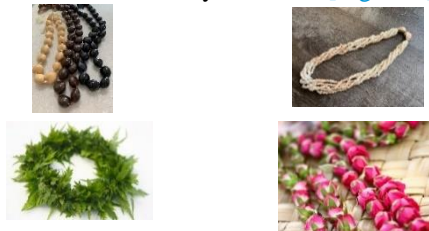
the hula. In this study, we focused on accessories, aiming to develop a CAD system for designing "leis," one of the accessories, and conducted a basic study of the system.[\[1\]](#)

### 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

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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[Figure 1] [2].



**Figure 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. 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.

## 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

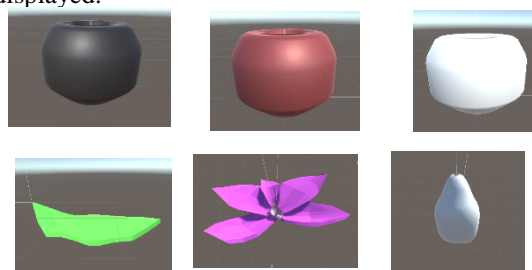
Six types of lei parts were prepared: "Kukui (white, red, black)," "Denfale (red)," "Maile," and "Shell."

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[Figure 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[Figure 3]. The number of parts used is also displayed.



**Figure 2 Types of Parts**



**Figure 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 =  $2\pi$

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

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

- E is determined by the following equation (2)

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

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

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

- Set i=0 and repeat the following from i to It

- Generate randomly from 4 cm to 7 cm

- Find the position Rat of the cycle (4)

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

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

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

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

- Rotate the part along the center of the circle.

## 3. Execution Result

Figures 7 show some of the results of this program [Figure 4]. The size, orientation, etc. can be adjusted in each case.

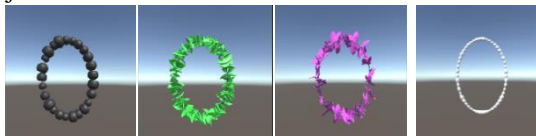


Figure 4 Execution results

## 4. Consideration

This study was extended to a 3DCG design program using Unity to create an interface design that can be operated more easily and to improve scalability by supporting multiple multi-platforms. In addition, the following functions were added: "adjust length," "display number of pieces," "display designed ray in real time," and "randomize material size."

As for the type of parts, there are still many materials used as material for the ray, so more part types and colors need to be enhanced. When displaying the design, the parts are arranged in an ellipse to make it easier to visualize the lei. However, because the size of the parts changed randomly, there were sometimes gaps between the parts. In order to prevent such gaps, it was necessary to be able to simulate the appropriate number of parts and their positions in response to the random size changes.

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

## 5. Conclusion

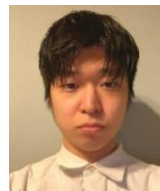
In this study, a prototype CAD system for ray design was developed through the creation of parts using Blender and 3DCG simulation using Unity. We were able to find various issues for practical use. In the future, we would like to continue to study various aspects, such as having a 3DCG fladancer wear the lei to visualize how it will look when finished.

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