Designing the Chinese Traditional Lantern Model and its Possible Effect in the Application

Zian Zhang

School of Letter and Science, University of Wisconsin Madison, Wisconsin, USA
zzhang2556@wisc.edu

Abstract. As computer graphics and three-dimensional (3D) modeling continue to advance, their applications have become ubiquitous in everyone's lives. However, traditional Chinese lanterns, a revered handcraft, have been largely untouched by these digital innovations. This is partly due to a lack of digitalization in lantern crafting education, resulting in decreased public interest. To address this issue, this study aims to explore the creation of digital Chinese lantern models and assess their potential in revitalizing lantern crafting education and industry. By adding a wooden holder and different lighting effects, this paper built a scene of the traditional Chinese family with the lantern model with textures and evaluated the effect of this whole scene by presenting it to audiences and collecting their opinion as data. The tool for modeling the Chinese lantern is Openscad. The whole scene shown to the audience is created and rendered by Three JS with other original models which help contribute to the final scene. The final evaluation gives a relevantly positive result in allowing the public to learn and raise interests in Chinese traditional lanterns.

Keywords: Chinese lantern, Openscad, Three js, 3D modelling

1 Introduction

The Chinese traditional lantern, also known as the Chinese lantern, originated in ancient China and has been used for thousands of years. People nowadays are still using the Chinese lantern frequently, especially for celebration and decoration. While this important cultural symbol and aesthetical handicraft is facing some challenges. The interests and enthusiasm of Chinese young people toward Chinese lanterns are gradually losing [1]. This lackness of interest and attention could cause some issues, including loss of traditional crafting skills of lanterns, lantern cultures, and human resources of the whole lantern industry. One main problem which leads to less interest is related to the difficulty of crafting a traditional Chinese lantern. According to research, art education in China lacks connection with STEM knowledge, and the education of traditional handcraft art like Chinese lanterns is hard to accept by new students [2].

Designing and modeling a Chinese traditional lantern could benefit both producing Chinese lanterns and help teaching students who try to learn about making lanterns. One idea is that some devices like augmented reality (AR) could bring more detailed

B. H. Ahmad (ed.), *Proceedings of the 2023 International Conference on Data Science, Advanced Algorithm and Intelligent Computing (DAI 2023)*, Advances in Intelligent Systems Research 180,
https://doi.org/10.2991/978-94-6463-370-2_54

interactions for students [3]. Different 3D models of the Chinese lantern could be imported to AR for students or any person who is interested in the lantern. Another idea is that digital modeling is precise and has complex details [4]. The digital models after delicate design are able to work with machines to automatically produce lanterns instead of making every single lantern by hand. Furthermore, the digit model of Chinese lanterns is easy to store, revise, and demonstrate compared to crafting one by hand. The time and resources take to revise a lantern after receiving feedback from customers will increase workers' burden. Additionally, designing the lantern model could help understanding various kinds of methods of how to create the Chinese lantern and the objects similar to that for future use. For instance, when a user counters some situation which might be able to apply a similar technique of creating a lantern shaped sphere, they could apply similar code or formula to form such a 3D model.

This paper aims to showcase the features of this Chinese traditional lantern model based on a 3D model and explore new techniques in the field of computer graphics.

2 Designing and Modelling the Chinese Traditional Lantern

This Chinese lantern model is going to be constructed using the Openscad. Openscad code is a great and economical format for the individual and community to get the model they want for 3D painting or other use [5]. Since there are so many different kinds of Chinese lanterns created during history, it is quite difficult to discuss all the different styles of lantern. The goal of this paper is suggesting the possible effect the digital model of Chinese lanterns can bring under the scene created later to mimic the situation where people are using the lantern, and this research is going to choose the classic sphere-shaped lantern to be the model (Fig. 1). This chapter is going to introduce some details of how each small component of the lantern is made and how they are combined.

Fig. 1. Picture of Chinese traditional Lantern (original)

2.1 Main Sphere of Chinese Lantern

The main body of this Chinese lantern is a hollow sphere (Fig. 2). Considering most lanterns have lighting functions instead of simply decoration, the main part is designed to be hollow in order to leave space for the light source. This hollow sphere model is formed by removing a smaller sphere inside of the main sphere. The “difference” in the Openscad helps achieve this operation. The main sphere is an oval which has a radius of 40, and a 1.4 scale in the x and y axis.

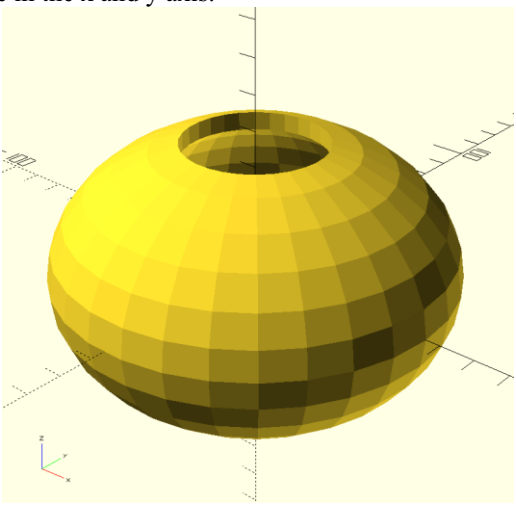

Fig. 2. The main body of Chinese lantern model (original)

2.2 Two Lids of Chinese Lantern

Two covering lids (Fig. 3) of Chinese lanterns usually have different texture and shape compared to the main sphere. There are two parts for one covering lids. The Outer ring is constructed by using the “difference” function to cut a whole cylinder by subtracting a smaller cylinder inside of a larger one. The differences of radius between two cylinders are based on the thickness of the ring. After the ring is made, a cylinder which could fit in the center of the ring is placed a little bit lower than the ring to form a complete lid. The radius of the whole lid is 20 and the radius of the inner circle is 16.

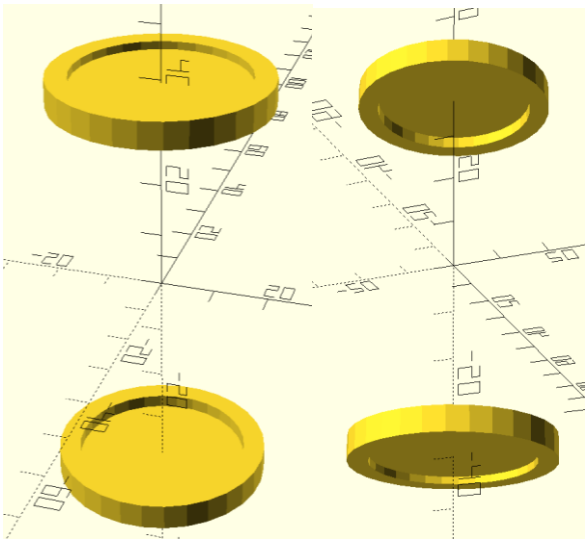

Fig. 3. The two covering lids of chinese lantern model, viewing from up(left) and bottom(right) (original)

2.3 Outside Frame of Chinese Lantern

The outside frames could maintain the shape of the main sphere and were used as a decoration on the Chinese lantern. Implementation of these frames is through creating twelve thin semi cylinders and circling them around the z axis (Fig. 4). These semi cylinders are placed on the position where the main sphere almost covers them inside of it. The rest of semi cylinders become the frames (Fig. 4), similar to how the thin metal frame on the lantern in the real world.

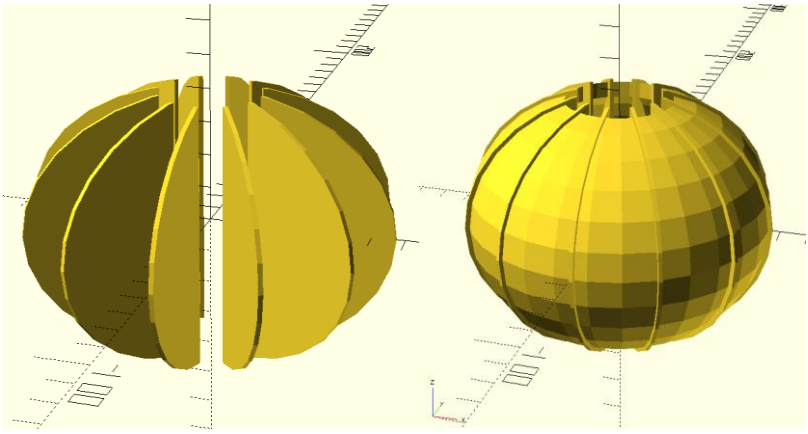

Fig. 4. Semi cylinders(left) and the frame it shows by combining with main body(right) (original)

2.4 Cord and Small Holder for the Tassels

Most Chinese lanterns are designed to hang on some objects. These two small cords are designed to attach to the covering lids (Fig. 5). Two thin cylinders are used to model the cords. The small holder for tassels is constructed by making a cylinder hollow.

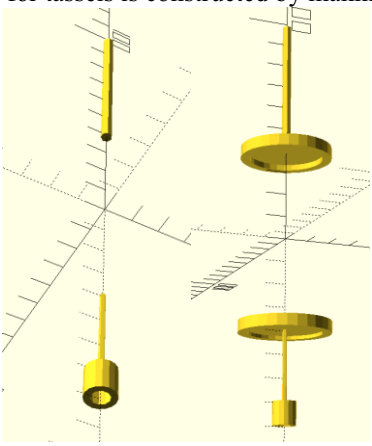

Fig. 5. cords and small holder(left) and the model after attached to lids(right) (original)

2.5 Tassels

In order to attach tassels (Fig. 6) around the edge of the circular holder and lids, the positions of placing these thin cylinder tassels are calculated by trigonometric functions. The program-based modeling makes the interval between every two tassels maintain the same.The tassels attach holders and lids are different in radius and length.

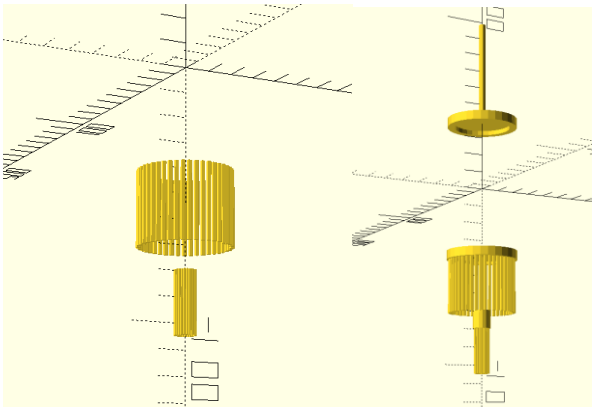

Fig. 6. two groups of tails(left) and the model after attached to holder and lid(right) (original)

2.6 Whole Chinese Lantern Model

After all of the previous parts are constructed, the full model of the Chinese lantern (Fig. 7) is done. By editing some Openscad code like the number of rings or radius of sphere, users could change the lantern to the style they want. The model could also be imported to other programs through format like STL. More detailed rendering and animation could be done to meet the needs.

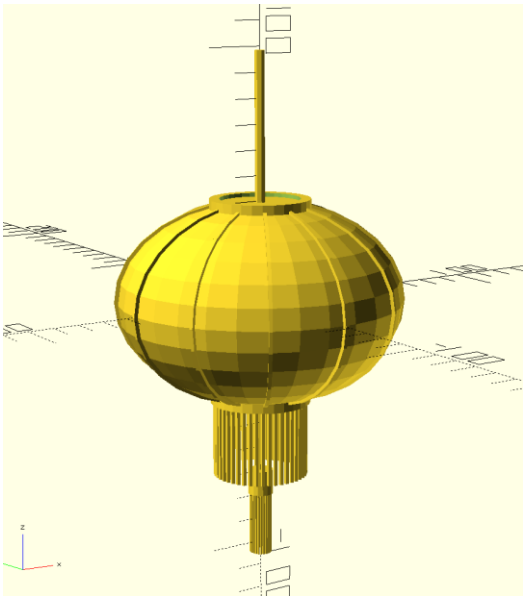

Fig. 7. Model of Chinese Lantern (original)

3 Placing Chinese Lantern Model into Scene

In order to demonstrate the advantages and function of this Chinese lantern model, a scene which mimics how Chinese lanterns are placed is important. A more realistic vivid present of the lantern can give viewers a basic understanding of how this model could be used when it comes to the real world. For example, placing lanterns in a scene where customers want could help manufacturers communicate with customers or advertise their products, and students who want to make lanterns can comprehend the usage of texture by applying it in the computer without extra material in the real world. The tool used for constructing the scene is Three.JS. Since Three.JS is based on WebGL, it provides lots of advantages for demonstrating the whole scene to the public. With webGL, the real time 3D graphics could be displayed on different browsers and platforms and allow lots of viewers to watch models access it in a convenient, efficient way [6,7]. On the other hand, Three.js is an easy tool for people to learn about the 3D modeling [8]. This feature could help people who want to build similar lantern model scene more convenient. It also be able to provide image with high quality for virtual reality and other mobile device [9]. By using this tool, this article could work better at

helping those learner and benefit Chinese traditional lantern industry. The detailed steps of how the scene is built up will be discussed in this chapter.

3.1 Adding the Basic Plan

In order to have a ground to place the lantern, a basic plan is needed. The geometry of the basic plan is set into 400 length and 400 widths (Fig. 8). The rotation of plan is set to $-\pi/2$ and the y vector of the plan is set to -150 to make sure the holder of the lantern could be placed on the plan without a gap or clipping through it. The white birch wood texture is applied to the plan by normal UV (U means horizontal axis and V means vertical axis) mapping, roughness mapping, displacement mapping, and AO mapping. The plan is set to be able to receive the shadow which allows the shadow of the lantern and holder present on it.

Fig. 8. Basic Plan (After Texture Mapping) (original)

3.2 Applying Texture and Material to Chinese Lantern Model

Single plain Chinese lantern model shows few features of lantern culture and has less chance to be accepted by the public. To provide a scene which is closer to reality, the lantern should be separated into at least two parts and applied to the texture separately. One part is the main body of the lantern model (Fig. 9). The texture used in this part is paper texture, and by adding the red color index in the parameter of mesh, the red paper texture which Chinese lanterns normally use is made. Similarly, UV, roughness, and displacement are used during the texture mapping process. In order to make the model lighting up the environment, the paper is set to be transparent and has a transmission rate of 0.8. The metalness is set to 0.0 to make sure it is closer to paper texture.

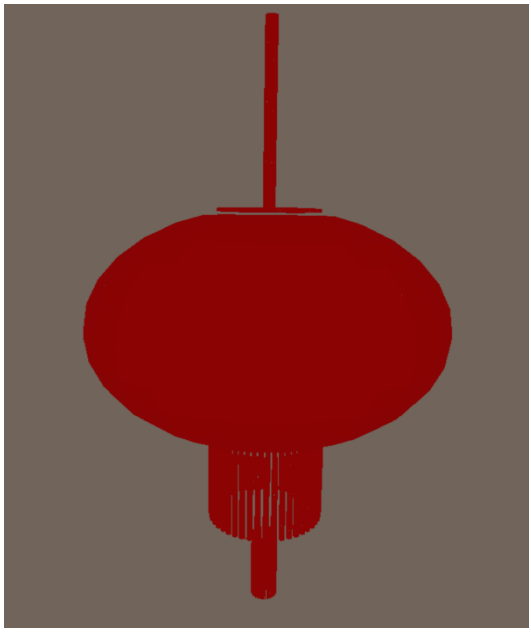

Fig. 9. Main Body of Lantern(different perspective) (original)

Another part of the lantern model is the part which normally needs to be gold, the frame of the lantern. The texture which will be applied to it is metal gold texture. By using normal UV mapping and metalnessMap, a golden frame part (Fig. 10) is done. Combining the main body with this frame part, the texture mapping for the whole lantern (Fig. 10) has been done.

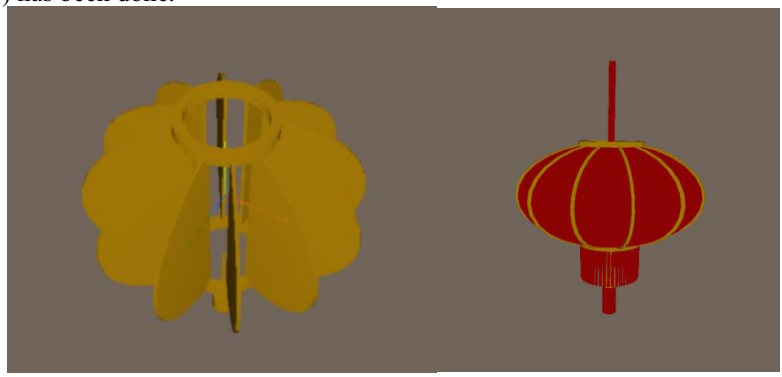

Fig. 10. Frame part of Lantern (Left) Whole Lantern Model After Apply texture (Right) (original)

3.3 Using Holder to Hang Up the Lantern

Having a holder for the lantern to hang on it could prevent the wield situation of having a lantern model floating above in the air. The higher position could help users see the shadow and the bottom part of the lantern. Dark wood texture is great for traditional Chinese lanterns (Fig. 11). This holder itself could function as decoration when it is used with the lantern model. Following picture is the holder with texture applied.

Fig. 11. Dark Wooden Holder (original)

3.4 Add Lighting effect to whole scene

In cinematographic images, lighting is a key element to build a visually rich graphic [10]. In order to make an audience feel like the scene shows to them looks as real as possible, it is important to add lighting and shading to the scene and make the audience feel comfort when showing them even with one screenshot. The first step of achieving this is by having a point light as a main light source which lights up the whole scene. It makes the object be able to be seen instead of having a dark object. By setting each object in the scene to be able to cast shadow and receive shadow, the shadow can appear on plan, other objects, even reflecting on the golden frame of the lantern (Fig. 12).

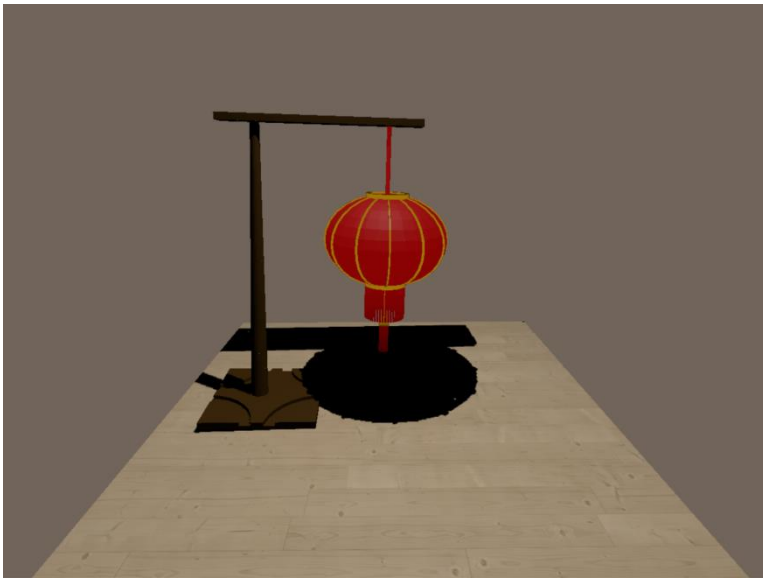

Fig. 12. Whole Scene After Adding the Main Light Source (original)

However, the Lantern itself should also be considered as a light source. In order to add a secondary light source of scene in the middle of the lantern model, an orange-red mixing color spot light is placed in the vector where it is at exactly the middle of the lantern sphere. This spot light has these features: 50% of intensity, 300% viewing distance, and radius of 1.1. The effect of this secondary light source makes the shadow become soft and has a light red color on it (Fig. 13). The reflection of the holder on the golden frame looks more natural and the wooden column has some red reflections on it (Fig. 13). These effects mimic the situation of lanterns lighting up the environment.

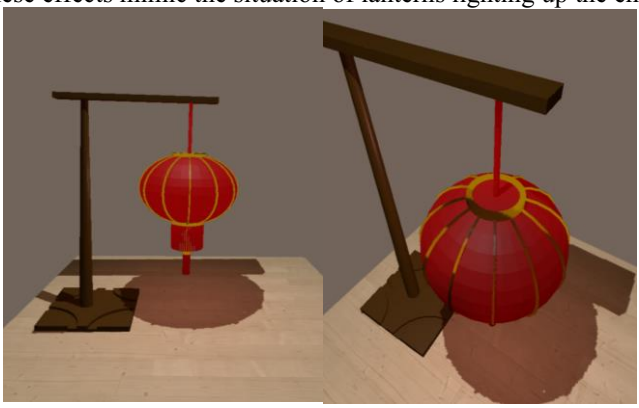

Fig. 13. Whole Scene After Adding the Secondary Light Source(Left) and Some Details(Right) (original)

3.5 Decorations for the Scene

The texture mapping and rendering are done for the scene, but there are some other elements that could be added for different purposes. Based on the viewer of the Chinese lantern model, several decorations could be added, like background, skybox, animation, and sound effect. Here is one example of adding a background image (Fig. 14). Overall, this small scene is just one way of demonstrating this Chinese lantern model, users could edit the scene by themselves to fit their demands.

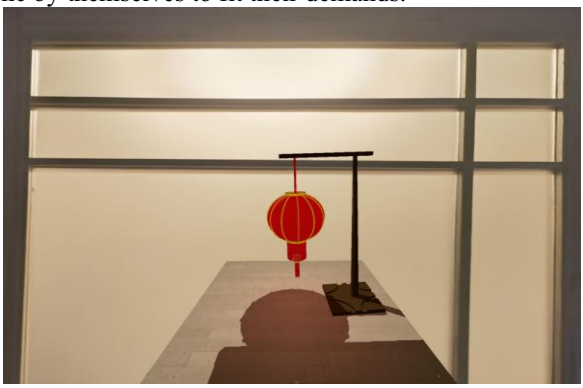

Fig. 14. The Scene After Adding a Background Image (original)

4 Evaluating the Effect of Chinese Lantern Model and Result

In order to know how this Chinese lantern model could trigger interests from the public, make people willing to use it, like for education purposes, and show its value and effects in the real-world application. Some research needs to be implemented to find out.

4.1 Evaluation method

Questionnaires are sent to several audiences through social media, including the screenshot of the scene. There are four statements in total. After they see the screenshot, the audience will choose from one of five-degree options for each statement, “Strongly disagree”, “disagree”, “neutral”, “Agree”, and “Strongly Agree”. Following are the statements in the questionnaire.

Statement 1 “This 3D modeling scene restores the appearance of the Chinese traditional lantern.” is designed to see whether this model meets the basic goal of looking like the real Chinese traditional lantern.

Statement 2 “This 3D modeling scene could be a possible reference for placing the lantern in the real world.” is designed to see whether the lantern model and the scene built early could mimic the real world application.

Statement 3 “This 3D modeling scene raises your interest in Chinese traditional lanterns.” is designed to see whether the model attracts the public.

Statement 4 “This 3D modeling scene helps you understand the form and structure of the lantern.” is to see whether the 3D modeling could function for various purposes from education, manufacturing, to future 3D modeling experience.

4.2 Result and Discussion

Table 1. Questionnaire Result

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Statement 1	5	4	2	0	1
Statement 2	5	5	1	1	0
Statement 3	4	1	6	1	0
Statement 4	5	4	2	1	0

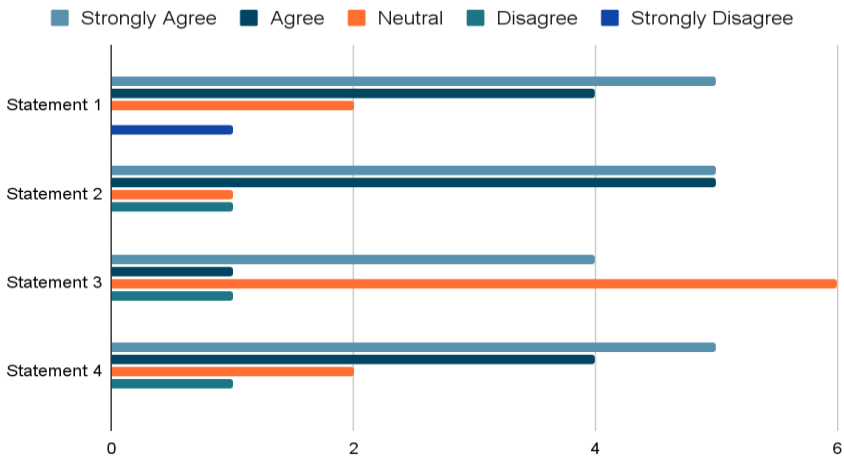

Fig. 15. Chart of Result Data (original)

There are 12 audiences who answer the questionnaire (Table 1). The results are relevantly positive and most answers for all statements are from “neutral” to “Strongly Agree” (Fig.15). During the design, the visual effect of the whole scene is based on traditional Chinese style and the feature of allowing moving the camera provides the ability to see the details of different parts of the lantern. These features reflect on the collected data. Three quarters of the audience suggests the Chinese model fits the image of what a traditional Chinese lantern looks like based on their understanding. Most audiences suggest that they could use this model and scene as reference to see what actual lanterns might work or look like in the real world, and three quarters of the audience suggests this 3D modeling scene helps them understand the structures and forms of

Chinese lanterns. For statement 3, half of the audience chose the "Neutral" option, and it could demonstrate the shortage of this Chinese lantern model and the whole scene that it needs some more attractive parts like vivid animation, more artistic details, or interactive parts. On the other hand, the method of attaching screenshots to questionnaires also limits the ability for the audience to interact with the scene, while there are still about 40% of the audience who think this scene raises their interests. Overall, the result of evaluation for this stage of the lantern model suggests a possible positive effect when applying this model. Further improvements and changes are going to be helpful to make it more effective.

5 Conclusion

The paper is intended to demonstrate the feature of this Chinese traditional lantern model and the effects and function during the real-world application. By using the Three JS to add lighting and other elements, this 3D lantern model, created by Openscad with purely code, forms a complete scene to mimic the real-world scenario. The main feature of this lantern is that it specifies and shows the different parts of the lantern and applies the different material and texture to each of them, which restore the feature of the real Chinese traditional lantern. This paper hopes this 3D lantern model could bring more interest in this classic handcraft and actual help to the lantern industry and building 3D modeling experience.

This paper contributes to the advancement of Chinese traditional lanterns by introducing new techniques and methods for their creation. As a future prospect, further research can explore the application of digital craftsmanship, incorporating technologies such as virtual reality and augmented reality, to provide more immersive and interactive lantern-making experiences. This will help facilitate the inheritance and innovation of traditional lantern craftsmanship, while also opening up new possibilities for industry development.

References

1. L. Y. Ming, E. Mohd Nasseri, and A. H. Husain, "A Study of the Current Position of Traditional Chinese Hanging Lanterns Among Young Chinese", KSS, vol. 8, no. 15, pp. 50–58, Aug. 2023.
2. Ji, Y., Liu, Y., Sun, X., Tan, P., Fu, T., Feng, K. Research on Chinese Traditional Handicraft Education Expansion Model Based on STEAM. In: Marcus, A., Wang, W. (eds) Design, User Experience, and Usability. Application Domains. HCII 2019. Lecture Notes in Computer Science (3), vol 11585, 2019.
3. Ji, Y., Tan, P., & Hills, D. "Chinese Traditional Handicraft Education Using AR Content." Leonardo, vol. 53 no. 2, p. 199-200, 2020
4. Uzlova, M., Zhurba, A., Zhuravlev, V., & Larionov, H. Development of a parametric model of a building of the educational institution in the OpenSCAD system. System technologies, 3(140): 124-142, 2022.
5. Nilsiam Y, Pearce JM. Free and Open Source 3-D Model Customizer for Websites to Democratize Design with OpenSCAD. Designs, 1(1):5, 2017.

6. Sawicki, B., Chaber, B. Efficient visualization of 3D models by web browser. Computing 95 (Suppl 1), 661–673, 2013.
7. Wang, Yuxiao, et al. "Large scale network topology visualization system based on Three. JS." 2016 International Conference on Artificial Intelligence: Technologies and Applications. Atlantis Press, 2016.
8. Liu Y, Liu H, Zhao Y, et al. Teaching of advanced computer graphics with three. Js, Proceedings of International Conference on Education and New Developments. 2016: 13-17.
9. Wang Y, Li Y, Zhang Q, et al. Large scale network topology visualization system based on Three. JS, 2016 International Conference on Artificial Intelligence: Technologies and Applications. Atlantis Press, 2016: 152-155.
10. Barzel R. Lighting controls for computer cinematography. Journal of Graphics Tools, 2(1): 1-20, 1997.