Design And Implementation of The Chinses Instrument Moon Guitar Base Openscad

Chenyu Hao

School of Engineering, University of Kansas,1450 Jayhawk Blvd., USA

* Corresponding Author Email: c082h002@ku.edu

Abstract. With the development of science and technology, 3D models used more widely in various fields. People can accurately understand the structure of thing by create model. Moon guitar is famous musical Instruments in China. People do not understand the structure of this because it lacks effective information on public internet. Building a detailed 3D model of this will try solve this problem. This paper was using the OpenSCad software to build a model. The model will be divided into several small parts and implemented separately. Assemble the small model, and getting texture on it. Update finished product to online 3D viewer. A large number of experimental evaluations show that the people very agree with the appearance and details of the model. There are still defects in the music feeling. The model can achieve the original purpose which people understand the structure.

Keywords: Chinses Instrument; Openscad; Moon Guitar; 3D model.

1. Introduction

3D model is a polygonal representation of an object, usually displayed by a computer or other video devices. With the development of the times, 3D models have been involved in various fields [1]. For example, the film industry used 3D models for active characters, objects, and realistic films [2]. The video game industry uses them to achieve game items and game characters [3]. Use them to make accurate models of organs in the medical industry [4]. Use them as precise models of compounds in science [5]. Because the technical aspect becomes gradually mature, human employ computer to take 3D model.

In other words, the use of 3D models can be divided into two aspects. The first aspect is for virtual use of computer. The second aspect is to create models so that people can more accurately understand the structure of things which is so small that it’s not easy to observe or High cost for construction [6]. This technology takes lots of convenience for people whether it is scientific research or work.

The Moon guitar is a traditional Chinese musical instrument. It also very famous in the world. However, there is one situation that exists now. There are only a couple of pictures and article on the Internet to show the structure of Moon guitar. It causes many people do not understand Moon guitar even have a wrong understanding of it. By investigate a situation, it's the lack of 3D model of Moon guitar which include very particular information on the public internet. Therefore, this research used the OpenSCad software to build a detailed model based on accurate data. After that, we get in texture on this. In this way, we can provide people with a more comprehensive model of Moon guitar.

2. The Design and Implement of Moon Guitar

2.1. Overall Content

In order to show the model more accurately, this paper designed the steps of the research, as shown in Figure 1.

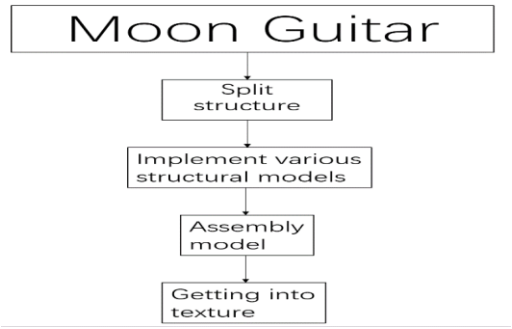


Fig.1 Model building process

Because many people do not familiar with the structure of moon guitar. This paper divides it into four steps: dividing moon guitar structure, implementing models by parts, combining models, and getting the texture on it. This maximizes the restoration of an accurate model.

The real moon guitar assembled by many small parts. In the same way, the research will be dividing into several small model. It is not only more accuracy but also people will realize the different function in different parts. splitting structure, the core part of this paper which is use the code to fulfill the models. The model can be accurate when each small model is highly implemented. the next step is assembly the model. this work was fit together couples of small models which we implemented before. Some places require minor adjustment of position and angle. Getting texture is final step on this. A number of images which is very homologous with real material will used by this paper.

2.2. Modeling

The software which this work used this time is OpenSCad [7]. This software is relatively easy to operate, whether people have an experience in programming or a person who has just come into the field of computer. This software not require user to install more anther software or adjust many parameters to run the procedure. It can materialize the shape of objects through code which the syntax is not difficult. The code is composed of basic functions. Each complete set of functions can implement a small model.

The Moon guitar is composed of three main components, so this paper will divide it into three parts by using the OpenSCad.

2.2.1 Upper parts

The upper parts have three small models, there are guitar head, guitar neck and guitar pegs. The head mainly used to ensure the stability and decoration of the moon guitar (Fig. 2). Among them, cylinder is the most common. Therefore, at coding part, the best way to achieve the head which is choose cylinder. The head is relatively small in the whole model, the height was set as 1.5 centimeter and radius was set as 2 centimeters. Furthermore, inserting one sphere which let the surface of the cylinder look smoother.

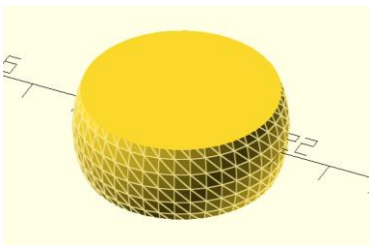


Fig.2 Guitar Head Model

The second part is the guitar neck. The upper part of the neck is provided with a chord groove and connect with head parts (Fig. 3). Also, the two side of chord groove will provided with a round hole for installing pegs. The lower part of the neck relates to the guitar body. The structure of the neck could be more secure for moon guitar. This step used three rectangles at coding. The three rectangles

length and height are same. The length was set as 4 centimeter and height set as 1.5 centimeter. The width is the only difference that the upper part is smaller than lower part.

Each moon guitar has four pegs. It needs to install to the upper neck part. The function of the pegs is connected with the music wire. using the cone at this coding part. the data of height set as 5 centimeters and the radius ser as 0.5 centimeters. After that, adding one half sphere at the cone bottom. It will more accurate.

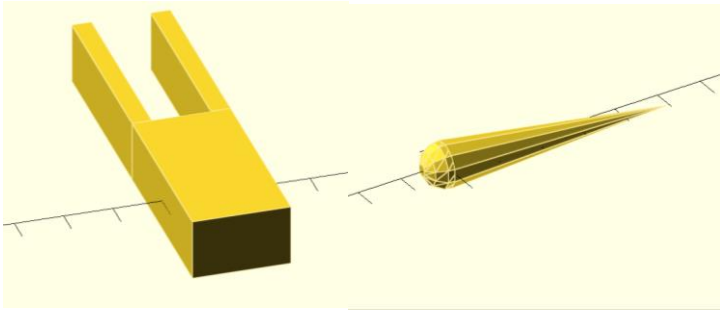


Fig. 3 The Guitar neck model and Guitar Pegs

2.2.2 The desigen of body part

The body part is biggest part of the model. it is a flat round pronunciation part which is composed of a surface and a frame. The cylinder will be used to the surface part and take one syntax which call difference function to the frame (Fig. 4). The cylinder height is 3 centimeters and the radius is 8 centimeters.

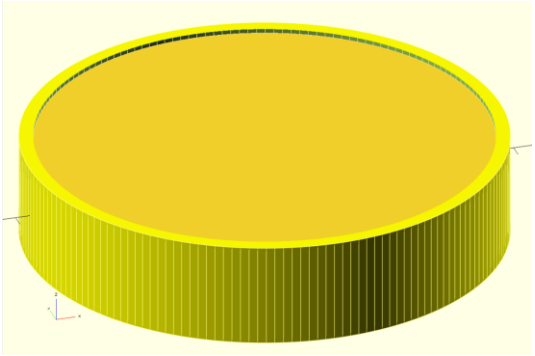


Fig. 4 Guitar Body Model

2.2.3 The desigen of panel parts

Panel Parts contains three small models: Guitar strings, pin, and binding stings. Moon Guitar has four stings of each moon guitar. The player will press the stings to make the moon guitar sound. This step uses the cylinder which is high height which set as 13 centimeters and small radius which set as 0.2millimetre to achieve this part (Fig.5).

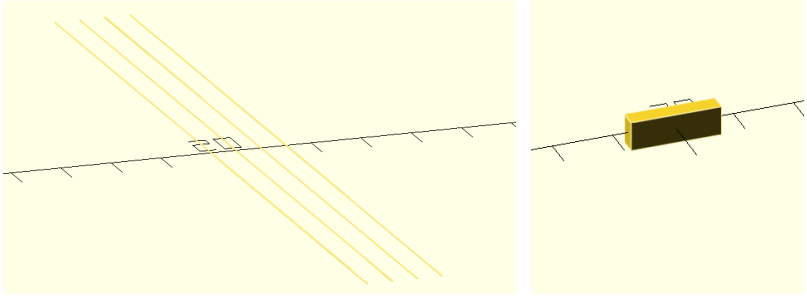


Fig. 5 Guitar strings and pin

This cube is call Pin which in Chinese. Each guitar has about ten Pin. It was installed at the guitar body and lower neck. The player can play different sound because they press stings at the Pin. Therefore, ten rectangles were using at the coding part. The last part is the binding stings (Fig.6). It

was installed at the middle of lower panel. The function of this is connect with the stings. Using the hale cylinder to achieve this part. That seven small parts of the model will assembly together.

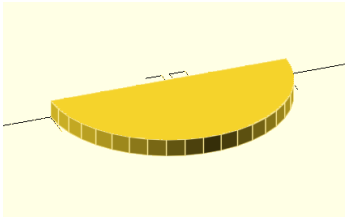


Fig. 6 Binding stings

2.3. Assembly Model

The seven small parts of the model will assembly together. This paper is the same as the installation steps of the real moon guitar.

As shown in Fig. 7, the three main body which are guitar head, guitar neck and guitar body will be fit together. In order to install them in a proper place. taking the guitar body as the origin point. The position of the neck and head have been adjusted. In addition, the head of the moon guitar should be tilted upward in the x axis.

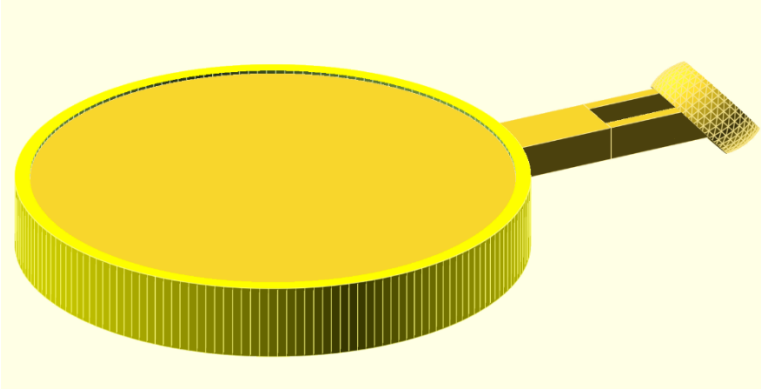


Fig. 7 Upper parts connect body part.

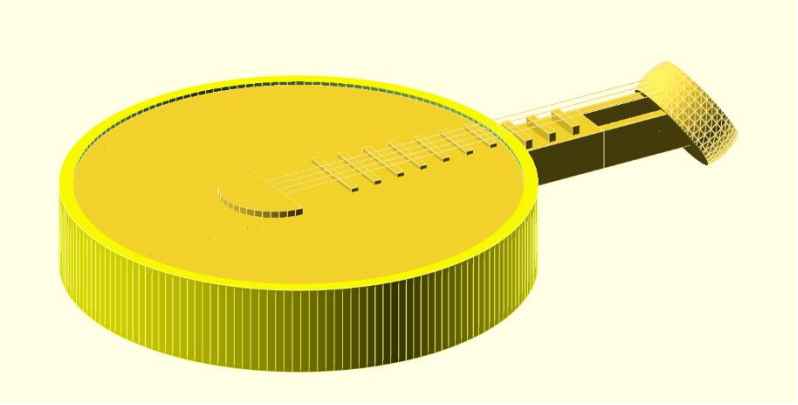


Fig. 8 Install panel parts

This step is assembling the little model which are binding stings and Pins to the main body part (Fig.8). The binding stings was middle of lower body part. Seven Pins was installed at the upper body part, three of this was install at the lower neck part.

The guitar pegs have been installed to the upper guitar neck. Each side has two pegs. After that, the four stings have been connected pegs. Every music sting was installed to each peg. The angle of each string which connect to pegs is different because each pegs position is different (Fig.9-Fig.10).

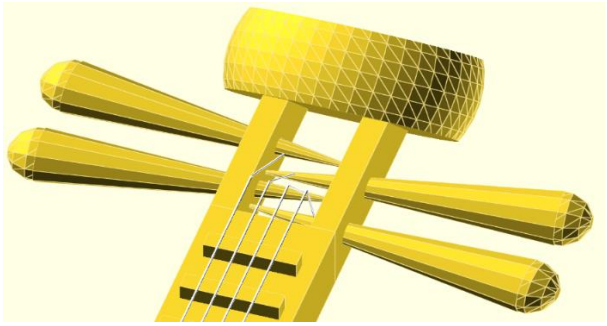


Fig. 9 Strings connect pegs

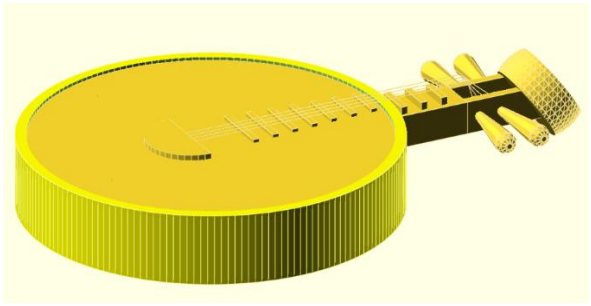


Fig. 10 Final assembly model

The strings must connect up and down. For down part, four of guitar strings were also installed to the binding strings. An intact and accurate moon guitar model is assembled.

2.4. Texture Mapping

Rendering which has many different types are last step of the modeling. To make the rendered graphics look more realistic. This paper will use the texture mapping which is using an image to achieve. Texture mapping provides a way to add more complexity and detail to a render [8]. Many software which has proven function can complete rendering. This step will use the Blender to rendering the model [9]. Blender is a free and open-source 3D graphics and image software that provides solutions from modeling, materials, and rendering [10]. The moon guitar model was design and implement at last step. In order to open it with Blender, the moon guitar file was changed to stl format. However, the stl file which imported by blender only have the geometry of the moon guitar. That means it is still a solid body in gray color without any texture information as show in Fig. 11.

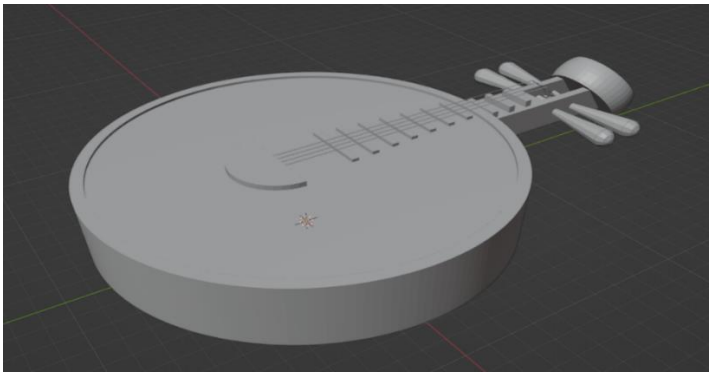


Fig. 11 Model open with Blender

Since this paper's goal is create a moon guitar as real as possible, instead of changing the material of the whole object. Therefore, the different parts of moon guitar model were applying textures. selecting multiple faces in the edit mode, and assign the different materials to individual faces. It is necessary to find some pictures that match the texture of the real moon guitar. The five of pictures which shown in as Fig. 12 was used in texture mapping. The pictures need to upload to the blender.



Fig. 12 Five picture of texture

At the blender edit mode, it has a function which call UV mapping can help user scanning all faces. The UV map for our moon guitar model as shown in Fig. 13.

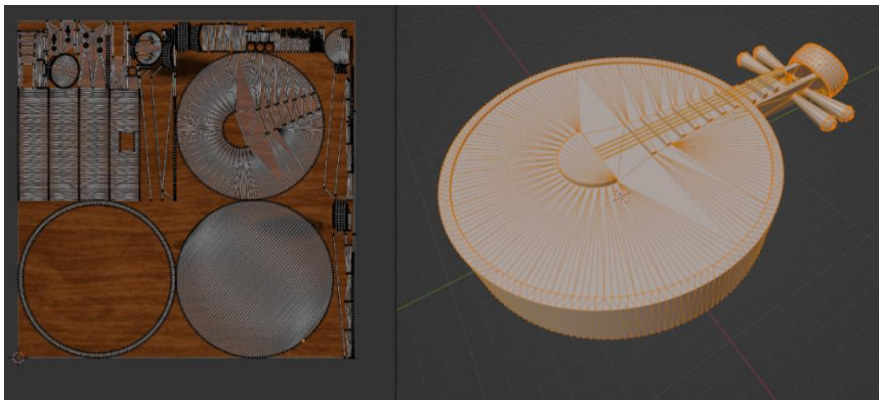


Fig. 13 The UV map for moon guitar

At Fig. 14, the first picture is similar with dark wood texture, it will use to the guitar frame, pegs and neck part. The multiple faces which need use this picture was select on the model. it will appear on the UV map.

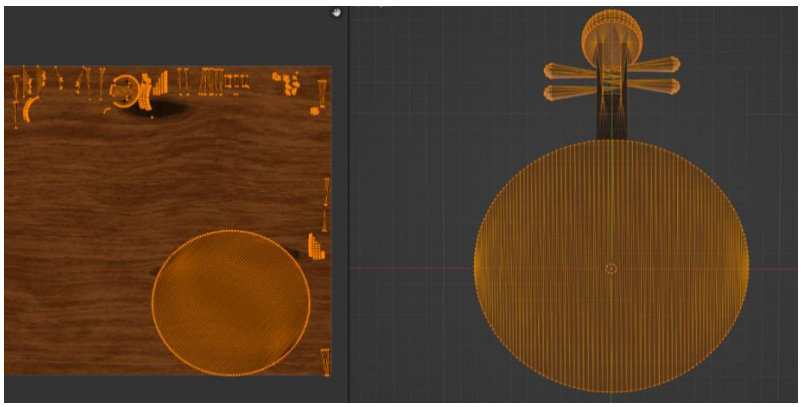


Fig. 14 The dark wood texture for the moon guitar

The second picture are using guitar body part. The third one was use guitar head. The guitar strings were use the fourth picture. The last one was use in Pins. Each picture has a corresponding position, and the operation method is the same as above. The final result is as Fig. 15.



Fig. 15. The final texture mapping of the moon guitar

3. Text

After the model is texture mapped, all production steps are completed. The model was saved as fbx format file. The final goal of the paper is to let more people understand the structure of moon guitar. The model needs to be able to upload to the network. The fbx file which contains the moon guitar model was upload the online 3D viewer.

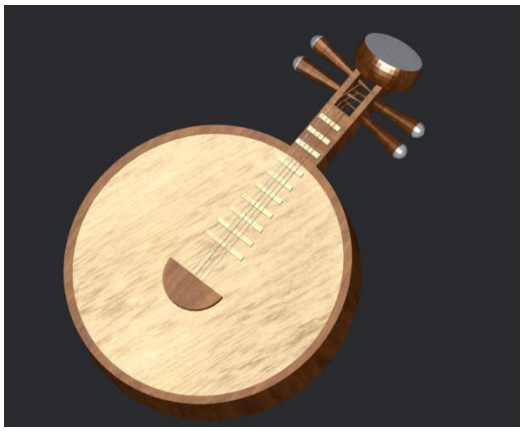


Fig. 16 Open in online 3D viewer

This is the effect of uploading files to the 3D online viewer. People can drag the mouse to rotate the model 360 degrees, and operate the wheel to zoom in or out. The model is the same as the degree of completion in blender. It contains most of the details of the real moon guitar.

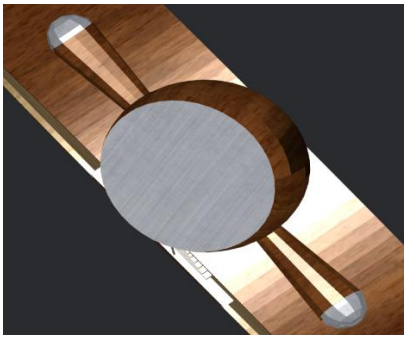


Fig. 17 Head part texture

At the guitar head part and side of the pegs. most of moon guitar are made of hardwood or bone ornaments. Textures approaching white are used here.

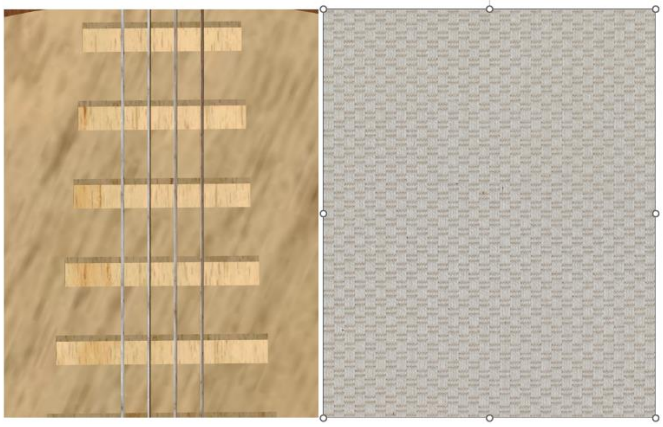


Fig. 18 String part texture

The strings have silk string and nylon string for the real guitar. The silk strings which showing at right side was choosing in this paper.

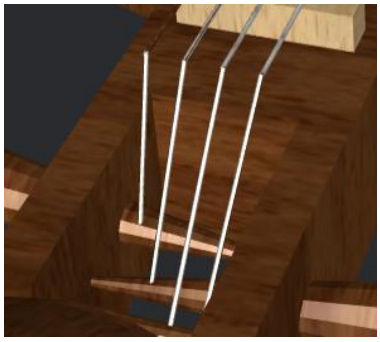


Fig. 19 Detail of the strings

One more detail which is the string connect to the pegs on this paper. This part is highly restored to the moon guitar. The material and structure details of the real moon guitar are reflected in this model.

4. Result

4.1. Experiment Setup

To verify whether the model is consistent with the real moon guitar, this text divided the model into four aspects to evaluate. There are model appearance, detail, texture and music feeling. There are 30 people was invited to experience this model online and gave evaluate. These people include students and workers in different occupations. The evaluate as three level which is agree, medium and not agree. They will evaluate as four aspects.

4.2. Comment Result Analysis

Through the model which designed in this paper, the evaluation is shown in the table 1, because proportion of appearance is very consistent. Therefore, the appearance of the model by about 86% people is highly agree with that of the real moon guitar. Also, most people approve the use of details and materials. They think that the details of strings connect detail and pegs are accurate. At texture part, they believe that the guitar head material is same with real moon guitar. Also, the silk strings are consistent. In the last part of the musical feeling. Because the strings of the model cannot be plucked. only half of the people think that it is a real moon guitar. This is the disadvantage of this paper.

Table 1 Result of evaluation

Recognition	Model appearance	Model detail	Model texture	Modle music feeling
Agree	26	23	24	13
Medium	2	3	1	6
Not agree	2	4	5	11

4.3. Discussion of Results

In general, most people accept the appearance and material selection. The appearance and material design of this model are successful. However, this model still has insufficient. Because the software cannot add an operable model, the strings cannot be plucked. Even if the strings can be plucked, the model cannot produce sound without designing the internal sound producing part. The main problem of inability sound is divided into two parts. The first part is the sounding device of moon guitar is designed by professionals, and the components are very complex. The second part is that plucking the strings and making sound requires different software to implement together, which is more difficult. In order to improve this shortcoming, it is necessary to find professionals to understand the internal structure, disassemble the internal structure and add it to the model in the future. On the other

hand, finding a software about voice production to combine with the model. After these shortcomings are remedied, the model is perfect.

5. Conclusion

This paper takes the design model as the theme, in order to let more people, understand the structure of moon guitar. The design model is divided into four steps. First, divide the moon guitar into several small parts to confirm the role of each part. Usinng code to implement the model of each small part. The models of each part were assembling in order. Finally, getting texture map with blender software. When the model is completed, upload the model file to online 3D viewer. The thirty people who have different job was invited to experience this model online. Among them, the appearance and material of the model are highly recognized, and the details are also considered to conform to the real moon guitar. At the music feeling part, because there is no internal structure and combined with other software, fewer people approve this part. In the future, this paper hope people can learn more about moon guitar through this model.

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