International Journal of Multimedia and Ubiquitous Engineering
Vol.11, No.6 (2016), pp.269-280
http://dx.doi.org/10.14257/ijmue.2016.11.6.23

The Design and Realization of a Popular Science Long Corridor Based on 3D Stereo Technology

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Abstract

Through the design and technical realization of a popular science long corridor based on 3D stereo technology, three hot applications of 3D technology including 3D folding technology, 3D holographic imaging technology and 3D printing technology were introduced in the paper. The three techniques as a whole in the popular science long corridor display the method to decrease the realization cost of the popular science long corridor. The interactive part of the two-dimensional animation was added into the popular science long corridor to reflect truly the effect of the computer technology integrating application.

Keywords*: 3D stereo technology, stereo folding, 3D holographic, 3D printing*

1. Introduction

In recent years, with the continuous development and integration of computer technology, internet technology and mobile communication technology, the method of internal popular science education is changing rapidly, 3D technology in science education be widely used, such as children's 3D stereo book, 3D model display, large three-dimensional painting, 3D movies,4D cinema, 5D film, *etc.* The popular science long corridor is based on the integration of the popular 3D stereo technology and it has some reform in the form of popular science popularization.

The main body of the popular science long corridor based on 3D stereo technology is folding science panels, which can be folded physical form through creativity computer designing. The formation of three-dimensional interactive science long corridor will make the audience to simulate the effect of some scientific experiments through flipping 3D folding panels, and intuitive understanding of scientific knowledge. These panels can be opened while exhibiting and can be folded into a plane easily other times to save large space being easy to carry and store. In addition, the science long corridor contains 3D holographic imaging booth and 3D printing model, the whole science long corridor can achieve the effective integration of multimedia technology, software technology and popular science knowledge finally. With the integrating application of three 3D technologies, it meets the needs of people's higher levels of appreciation.

At the same time, in order to reflect better the interaction with the audience, the popular science long corridor make use of flash animation played by notebook computer synchronizing. The flash animation will visualize static exhibits to become continuous effect with a set of audio, animation, text, *etc.* The animation can not only enhance the stereo space understanding for the folding science exhibit [1], it can also make the audience answer science knowledge problem through interactive flash animation to obtain a small prize increasing the interaction of the science education.

ISSN: 1975-0080 IJMUE

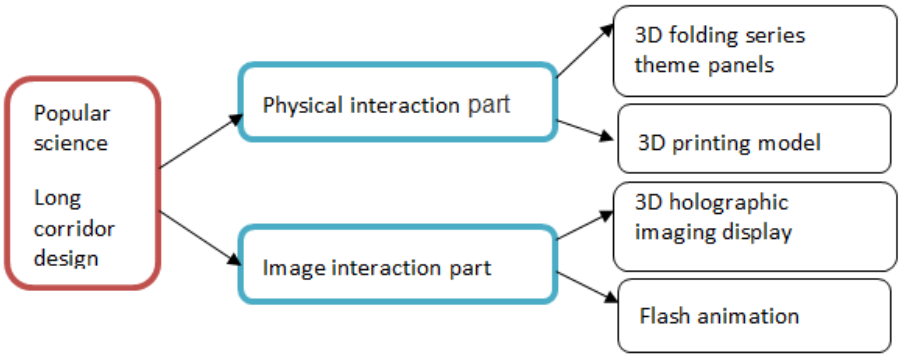

Figure 1. The Framework of a Popular Science Long Corridor Based on 3D Stereo Technology

The popular science long corridor based on 3D stereo technology can be exhibited in a variety of occasions, such as Science and Technology Museum, large playgrounds, parks, school playgrounds, Community Street, Commercial Street, and other personnel intensive places. The good national publicity and education effect can be achieved by this novel.

2. The Basic Theory of the Popular Science Long Corridor Based on 3D Stereo Technology

2.1. 3D Stereo Folding Technology

3D folding technology originated in the paper sculpturing art. Paper sculpture, also known as paper embossing, its origin can be traced back to the Han dynasty paper invention in China and the Germany's improvement for the paper in the 16th century. Paper sculpture is a technology using paper as material and also using cutting tool to mould. So far, the paper sculpture is still the vanguard in area of three-dimensional illustrations industry [2] and has advantage in foldable property. The difference between 3D folding and the paper sculpture is that the plan of 3D is designed with a computer in advance to produce exhibits quickly and accurately.

3D stereo folding technology is the combination of the image processing technology and the paper sculpture technology. The effective integration of traditional art and modern technology can be achieved through the method. 3D stereo folding technology can be applied to stereo cards, 3D stereo book, three-dimensional panels and other interesting paper products. It is widely loved by young children.

2.2. 3D Holographic Imaging Technology

3D holographic imaging technology also known as the virtual imaging technology is a kind of 3D technology to see virtual objects or images by the naked eyes without special glasses started from 1948. As a new optical imaging technology, 3D holographic imaging technology has made the major contribution to the classical optical [3]. Using the principle of interference and diffraction in 3D holographic imaging technology, the objects in real three-dimensional image could be recorded and reproduced. The technology not only can produce three-dimensional aerial phantom, but also make the phantom interact with the performers and complete the performance together to produce stunning performance results.

The technology is applicable to the product exhibition, automotive fashion show, stage shows, bars and entertainment, interactive projection and other places, *etc.* If this new projection technology is used in the future teaching, the teaching methods will become more flexible, dynamic, immersive and involve in the new model of multidimensional

space [4]. The students' interest in learning will be improved and a new teaching mode will be created by using of the technology's potential revolutionary mode of teaching and learning [5].

2.3. 3D Printing Technology

3D printing technology is a rapid prototyping technology based on a digital model file began in the 80s of last century. Many adhesive materials such as powder, metal, ceramic, plastic or multifunctional nanocomposite [6] and so on are used to shape a solid model by printing layer by layer. In the future, 3D printing technology will profoundly change the mode of the traditional industry from traditional manufacturing to intelligent manufacturing [7].

As the basic process to achieving 3D printing works, firstly, the model is built with computer modeling software, 3D model is sliced one by one layer through the "partition" with step by step secondly and guide the printer to print layer by layer. The working principle of the machine for 3D printing is basically the same as the ordinary printer. The main difference between them is that the printed material. The print materials of ordinary printer are ink and paper, but 3D printer can use metal, ceramic, plastic, sand, different "printed materials" and other real raw materials. After the 3D printer was connected with the computer, the computer can control "printing materials" layer by layer. Finally, the model on the computer will be printed. Generally, 3D printer is a kind of device that can "print" real 3D objects, such as a character statue, cartoon characters, car toys, *etc.* It can create almost any shape of goods and be called "printer" popularly. Because it refers to the technical principle of the ordinary printer, the process of lamination processing is very similar to the ink jet printing, the printing technique is known as 3D stereoscopic printing technology.

Currently, 3D printing has been widely used in machine manufacturing industry, automobile manufacturing industry, aerospace, construction, the protection of cultural relics, jewelry processing, clothing design, game design, 3D Studio, creative gifts and many other fields, even applied in medical field[8].

3D printer hasn't yet reached the maturity level. It has some limitations in the printing material and can't support all materials. In addition, 3D printing technology is only printing the static objects and can't scan dynamic objects currently. Moreover, the price of 3D printer is higher than ordinary printer, and its printing time is longer than ordinary printer, so it is unable to popular in the ordinary family. However, 3D printing may change the development and production of many products that indicates that the coming of "a personal manufacturing era" [9].

3. The Realization Technology of the Popular Science Long Corridor Based on 3D Stereo Technology

3.1. The Realization of 3D Folding Techniques

In the actual production process, we realize the 3D stereoscopic folding panels through three steps (Figure 2).

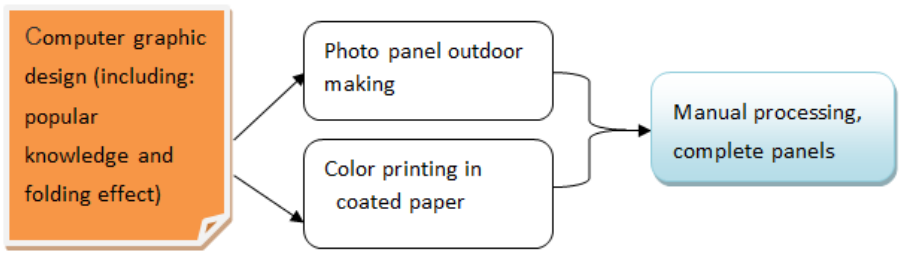

Figure 2. The Design Process of 3D Folding Panels

3.1.1. Computer Graphic Design

The commonly software of computer graphic design is Photoshop. The more popular Photoshop CS5 is used to design the science to give full play the software strong power of graphic design.

Considering the showing efficiency and printing color, the resolution is set as 300dpi at beginning of design. The two problems appear in the design process. At first, the whole design time is greatly affected because the design file of the guide panel has a large capacity resulting in a slower process. Secondly, in the process of the planar graphs design of 3D folding panels, the reasonable and interesting of the interactive content should be considered, in addition, the picture' size in the folding part need accurately calculation. And the folding part must coincide with the size of the whole panels, because a slightly error would lead to the redesign and printing of the whole photo. In order to solve the above problems, the work is broke down, the design is integrated while each part completing, and the calibrate work of all sizes is responsible by professional, thus the design error is reduced to the minimum.

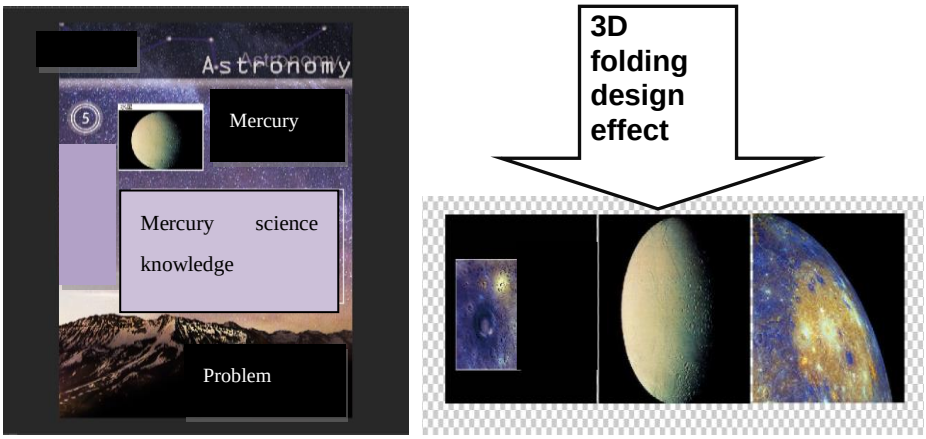

Figure 3. Mercury Science Panels and the Effect of 3D Folding Design

Through collecting network literature data and looking up a large number of books, the astronomy knowledge and chemical knowledge are taken as the exhibition content of the 3D folding panels. Considering the higher abundance and popularity of the astronomy knowledge, the ratio of the number of astronomical and chemical panels are designed for 2:1. Each panel's design is divided into the main content and the folding portion, that is, two documents are needed to achieve a 3D folding panel effect shown as Figure3.

When designing the subject files of a panel, the introduction order of the popular science knowledge should be considered, there must be a certain order between the front and rear panels to avoid the large jumping of the panels content. In addition, the position of the folding effect should be reserved. During the design of the folding effect, the content of 3D folding is the supplement of the main content, and it should fully reflect the interaction with the audience, and its form can able to attract the audience to repeat operation.

The computer design process can be said to be the most important part of 3D folding panels. In order to increase the creativity of the design, a large number of 3D stereo effect books are referred, design being repeated, and A4 color coated paper being printed. Only the correct test, we can enter the next process. All the unsatisfactory effect of the 3D folding should be revised design, until satisfaction.

3.1.2. Object Printing Process

Due to the high cost of material printing, the computer design manuscript should be reviewed repeatedly and enter the printing stage until no error. And the interesting of the design is focus of the examination in this process.

To achieve 3D stereoscopic fold effect, the computer design draft of the popular science long corridor is printed with two parts. The main part of the corridor adopts outdoor photo covered by cold plate effect. The 3D folding design section adopts 200g chrome paper printing being convenient for hand-cut and folding.

In the designing of the electronic draft, A4 paper is taken, and the effect of outdoor photo covered by plate adopts consistent size of 850× 600 mm^2, which make the final ratio of picture is very coordinated.

During the designing, multi folding flat panels' file are integrated into a .PSD file through repeated modifications to save follow-up link costs as much as possibility and reduce the number of the final electronic document.

3.1.3. The Manual Production Process of 3D Folding Panels

Referring to the form of the stereo cards, 3D book' process, a three-dimensional folding effect is easily realized by using scissors, ruler, double-sided adhesive, transparent plastic and so on to cut and splice the coated paper. The manual production process required fine operation, a slight mistake will ruin the picture to cause unnecessary waste. So this step is very important.

In the manual production process, the following problems exist:

First, the larger size chrome paper folding portion is difficult to support effectively to cause the chrome paper bend easily.

Second, it is obviously inconsistent when the folding panels stand and flat. Some chrome disperses easily when the folding panels stand.

To this end, the above problems have been solved through repeated scrutiny. For the first problem, to stick a cardboard on the back of the chrome paper, and the cardboard has close color and favorable hardness. The chrome paper can be effectively support. For the second problem, one same color paper is hand-folded into a similar frame border to add decorative effect. The color paper is pasted in the proper position on the panel to form a reinforcement line, the separated chrome paper can be closely together with the folding panel. In the interaction, the audience can withdraw the chrome paper from the reinforcing wire, the interaction effect is greatly improved. The following two images are the effect of the improvement.

Figure 4. The Folding Effect of 3D Stereo Panels

Figure 5. The Folding Effect of a Large 3D Stereo Panel

3.2. The Simple Method to Make the 3D Stereoscopic Holographic Image

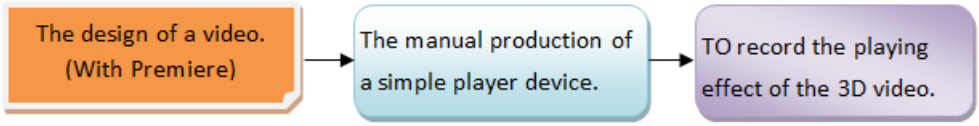

Figure 6. The Simple Method to Make 3D Stereoscopic Hologram

3.2.1. The Design of the Video

The equipment and recording process of the 3D holographic video source must be very professional. With the holographic technology entering the fourth generation [10], the holographic image production is getting better and better, such as the design of the stage person or the exhibits phantom.

Under relatively simple conditions or limited cost, to create simple video source is a cost-saving program and more time-saving way. NLE video software Premiere can achieve the effect as Figure 7.

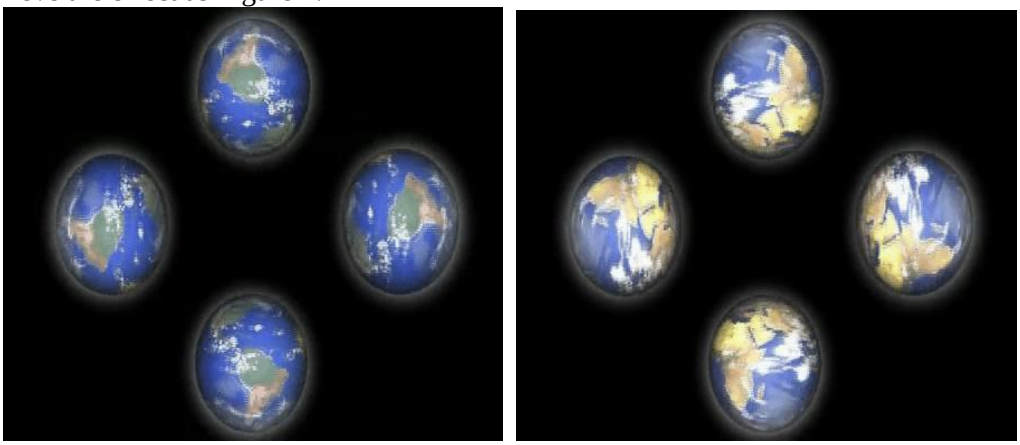

Figure 7. A Simple 3D Stereo Holographic Video

The object's four faces are collected in one frame by the software, the continuous multi frame images display four angle during the video playing. In the special projection device,

four angles are organically integrated to form a 3D holographic image. The obvious phantom effect has extremely high scientific significance.

3.2.2. The Manual Production of a Simple Player Device

The rejection screen and projector cone are the usually 3D holographic player devices. As Figure 8 showing, the device is transparent, it can receive images from four angles, and ultimately form a 360^{o} holographic image.

These player devices are typically used in the area of business, but their costs are usually higher. A simple manual device in the laboratory can achieve very good effect.

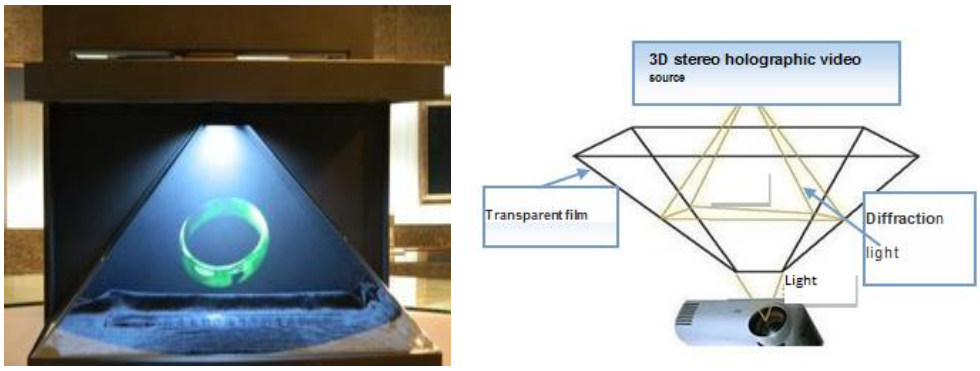

Figure 8. The Principle of the 3D Stereo Holographic Playing

The specific measure is to make a conical projection device using hard transparent plastic films. The base size of the device is substantially equal to the width of the phone's or iPad's screen, and thus form a micro-holographic projection booth. The entire 3D holographic image displays when the video is playing in the phone. Figure 9 is the experimental result.

The device has four triangles, and each triangle has the same angle. A vertex angle of 70 degree is used, two corners are 55 degree. The size of the design is different according to different projection instrument. The bottom length is determined by the width of the projection instrument. The most common projection instrument is the mobile phone for its easy to carry. Then the length of the bottom side of each triangle is usually designed to 5.5cm.

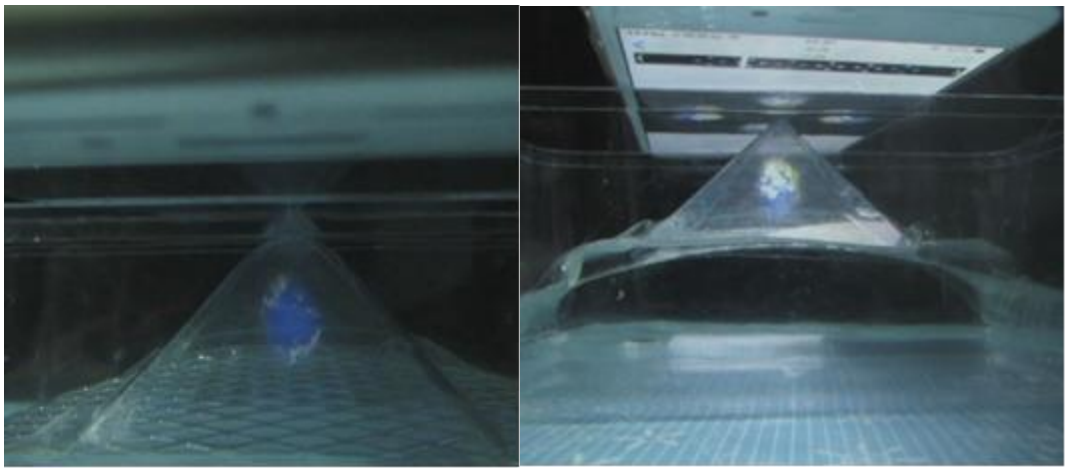

Figure 9. The Playing Effect of a 3D Stereo Holographic Image

The next process of making a 3D holographic imaging device is to strength the four triangles of the device by transparent tapes. And the last is to make a transparent plastic

box, and the plastic box is not required too big, as long as it can ensure the small player device be put into. So far, the maker of the box is success. In the end, the wonderful holographic projection effect with the phone can be placed in the top of the plastic box.

3.3 The Design and Making of a 3D Printing Model

3.3.1. The Digital Modeling of 3D Printing

An important part of 3D printing technology is the model design with computer. At present, 3Ds max and MAYA are usually used in the digital modeling of 3D printing, both the two software are very easy to master. The key of modeling is the conception, the whole of the model should be showed as far as possible. The eventually file format is STL, and this file format is a common 3D printing recognizable format [11].

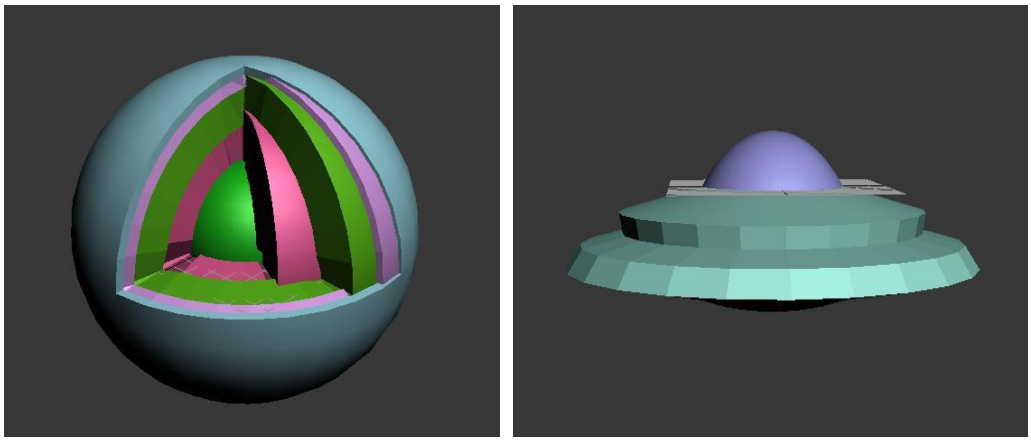

Figure 10. Self-Created Model of 3D Printing (Sun, UFO Works)

STL is a file format that expresses solid surface data with triangular facets. It is a collection of several small triangular patch of space, and each triangle patch is represented by three vertices and normal vector pointing to the model outside. The format is similar to the finite element mesh. The surface of the object is divided into many small triangles to approximate the solid model. This describes a model with enclosed space, bounded, regular, and unique expressing object and it contains points, lines, and plane geometric information. So, it can express the surface information of the entity completely [12]. The STL format file can be export form by 3Ds max and MAYA software (As Figure 10).

3.3.2 The Collection of STL File

STL file can be downloaded through internet in addition to design model. As a hot area of development, there are many works of 3D printing in the network. Many files are freely exchange and sharing. Now, many of them are free to share, therefore it can save a lot of time.

3.3.3 The Main Problem of Model Printing

It’s necessary to make error detection and repair for STL file before the 3D printing model official print. Some special software can be used to repair it. Following problems are usually encountered to print self-design works. In the first, many models need to add additional support, and this required specialized software. Second, larger works printing usually need a long time, even some need more than 10 hours, a great deal of manual labor for workers are required.

The next important task is to remove the support after the model has been printed. It would leave some traces in the area of the support. Now, such a trace won't affect the aesthetics and the using of the model.

3.4. The Design of Flash Animation

As professional 2D animation design software, the exquisite images of Flash animation can help increase the observability and interactivity of the scientific knowledge.

The design of the exhibition content animation and interactive quiz can not only enhance the multimedia application effect of the science long corridor, but also allow the audience to participate in the interactive and repeat viewing animation effect. And then the audience can increase the perceptual intuition to the scientific knowledge.

Figure 11. The Interface of Flash Animation for Astronomical Science

The technology of the Flash animation making is easy. However, the topic selection and interactive design of the content is very difficult. For the exhibition contents of the folding panels are static exquisite showing, the Flash animation isn't simple repeat to the panels in the content, but is an effective supplement. The animation can attract the audience's eye with the interaction part and science quiz.(As Figure 11, Figure 12)

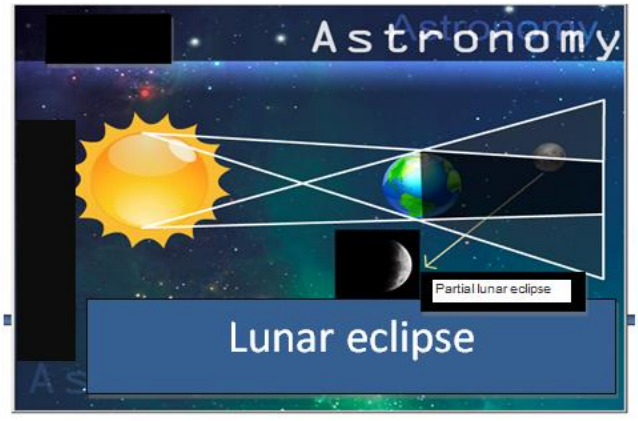

Figure 12. The Animation of Lunar Eclipse

4. Conclusion

The popular science long corridor base on 3D technology has been fully realized in practice, good effect has received through the exhibitions to primary schools, communities and enterprises and other units. The fusion of 3D printing technology, 3D holographic imaging technology, 3D folding technology and 2D animation in the popular science long corridor were much loved by the audience. The long corridor has not only achieved the perfect combination to embody the advantages of repeated using for the material object, but also strongly promote the new technology.

The 3D folding panel is beautiful, practical, easy to transport and easy to move as the main body of the popular science long corridor, it hasn't special requirement for the scale of the exhibition area, and the exhibition method is flexible and diverse. It can be fixed display and also be displayed with other science exhibits. It can be used as a novel form of a separate science exhibition sometimes.

The realization of this science long corridor has promoted the full contents that people loved science knowledge, and the showing support and platform are high-tech means that people talking about. So, the long corridor has a value of science propaganda itself. Therefore, this science long corridor can be "copied into" a new science exhibition theme by a little update. This science long corridor can be entirely leaved to the similar science activities for its multi-technology integration effect. The exhibition places of the whole science long corridor are very widely. It can be applied to parks, communities, schools, commercial streets, exhibition halls and other crowded places.

The whole science corridor has certain creativity for the integration of 3D technology, 2D technology, the low DIY's cost design process, as well as its innovative ways to promote.

The WeChat public platform can also be adopt to as a very popular form currently. It can make faster network transmission for its huge amount of users. The showing in the WeChat has expanded the subject of the popular science long corridor. People can learn the science knowledge and 3D technology through the platform in long-term to achieve the effective integration of the traditional science and the modern science.

Acknowledgements

The results of this paper come from Qingdao popular science project of 2014 annual. The project is "The design of popular science long corridor based on 3D stereo technology", its fund is 20000 Yuan. Aiying Mao is the project manager.

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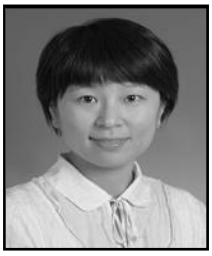

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