AN INTERACTIVE GLOBE CONTENT BY PROJECTION MAPPING TO A HEMISPHERE

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ABSTRACT

To display information about the world or the earth, use of globe is often effective. As a simple and reasonable priced spherical display, a projection mapping onto a white hemisphere object is done. A hemispherical Styrofoam is placed on a display table, and a display projector is placed above the hemisphere, then projection mapping of onto it is done for displaying a globe. Using the proposed device, an interactive globe content is implemented. This method is expected to be used for exhibitions in museums or as a leaning material at school.

Keywords: Projection mapping, Globe, Hemisphere, Exhibition technology

1. INTRODUCTION

For information contents of the world or the earth, use of a globe is effective. It is attractive especially for exhibitions at museums or learning materials at schools. For static contents such as a world atlas consisting of lands, oceans, and mountains, a physical globe using plastic or wood can be made. However, for dynamic contents which change information in real time, physical globes cannot be used so that flat panel displays are used usually. To realize more attractive contents, spherical displays may be used. However, in general, spherical displays are expensive and they do not meet budget requirement. Thus, I have proposed a method of projection mapping onto a hemisphere object, as a cost conscious reasonable solution to realize a spherical display [1] [2].

In this paper, the proposed method and its implementation will be explained and then an interactive globe contents using the proposed device will be introduced.

2. EXISTING TECHNOLOGIES

2.1. Spherical Displays

There are some spherical displays in commercial market or in research. Some of them are custom made for specific purposes.

For example, Geo-Cosmos [3] is a large sphere which is covered by many LED units on its surface. “Sphere” [4] developed by Microsoft research is a multi-touch interactive spherical display. “WONDER MOMENTS,” [5] at NIFREL aquarium is the lighting installation art of a big sphere whose diameter is 5 meter. Multiple video projectors shoot the sphere to display artistic scenes. “Panorama ball vision,” [6] is a spherical display by a high speed spinning LED bar.

Also, there are some products in commercial market. For example, “Dokodemo Ball,” [7] which means “a ball everywhere” in Japanese, is a white acryl ball display placed in front of a video projector with a fish-eye type wide lens. “Dokodemo Dome” [8] is a hemispherical display by a back projection of a video projector. “Cristal ball display,” [9] is a transparent plastic sphere display.

2.2. Projection Mapping Technologies

Projection mapping is a method to project visual contents on to non-flat surfaces. The core technique is deformations of visual contents to fit on non-flat surfaces.

As outdoor entertainment shows, projection mapping onto architecture such as a castle or a building are the major application of the projection mapping. They are sometimes called as architecture mapping. Multiple projectors are usually used.

As indoor entertainment shows, it is used on stage in theaters.

3. A PROPOSED METHOD OF PROJECTION MAPPNG ONTO HEMISPHERE

3.1. A Proposed Method

Here, the proposed method, which uses projection mapping onto a hemisphere is explained. Figure 1 shows the overview of the method.

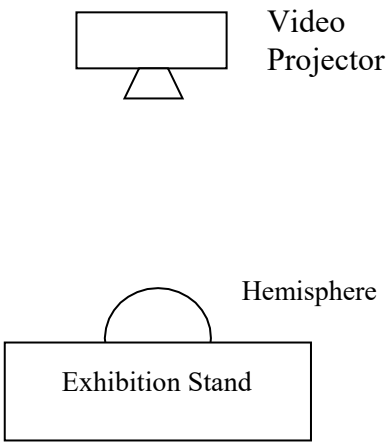

Figure 1. Projection mapping to a hemisphere.

Only a single projector is used to project on a hemisphere rather than multiple projectors to a sphere.

To use this method, the cost of the device will be low. It does not need multiple projectors nor special devices. As a hemisphere display screen, a Styrofoam hemisphere is currently used as shown in Figure 2. Diameter of this hemisphere is 25 cm.

Figure 2. Styrofoam hemisphere

In addtion to the cost down of the devices, software implementation of the contents will be simple and easy. Overlapping of multiple projectors are not needed. Adjustment of a projector is easy, too. Also, deformations of the visual contents are easier.

4. IMPLEMENTING AN INTERACTIVE GLOBE CONTENT

4.1. Development Environment

To model a globe, a picture editing software ("Photoshop") is used. The current version of the software can handle 3D surfaces. Texture mapping onto 3D surfaces can be done. Also, a simple animation can be done.

For interactive dynamic contents, "Unity" is planned to be used. However, so far, for a prototyping purpose, "WebGL" is used, because its programming is simple and flexible. Deformations to fit hemisphere surfaces can be programmed. Deformations are based on affine transformation. Other software such as "Animate" ("Flash") may be used in future depending on types of contents. More simply, animation functions of "Power Point" can be used to make contents.

4.2. Modeling and Deformation

This time, an interactive globe content is made. A simple globe rotating by a mouse is implemented.
World atlas by spherical Mercator projection is used for the globe data. Figure 3. shows the data used.

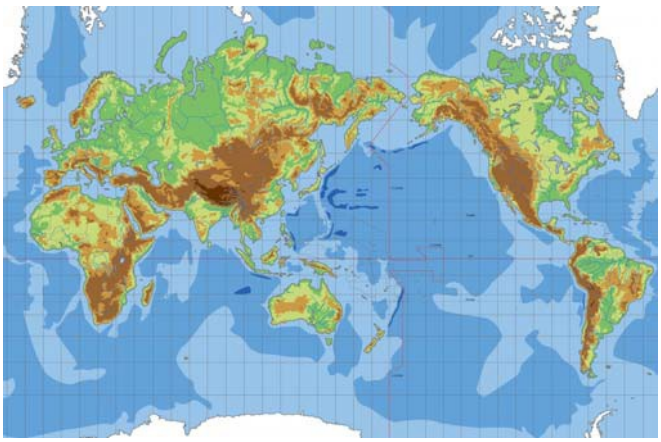

Figure 3. World atlas data in spherical Mercator projection

Next, a 3D model is made. The model must be matched to geometric formations of the screen object, that is, a hemisphere. However, for the modeling, a sphere is used rather than hemisphere. Because its reverse side is invisible so that its rendering result will be data of hemisphere.

Next, texture mapping of the world atlas data onto 3D sphere model is done. This can be done by application software or programming with computer graphics libraries. Once modeling with texture is completed, the model can be scaled, rotated, or deformed with the texture.

Rendering is the final step to make visual contents sent to a projector. Realtime rendering is needed for interactive use which can be rotated by a mouse or a track ball.

For non-interactive contents, high quality final images can be rendered offline. The rendering is done video frame by frame, e. g., 30 frames per second. Combination of realtime rendering and offline renderring in a content is good, too.

Figure 4. shows a rendered globe. The data are ready to sent to a video projector.

Figure 4. Rendering result of texture mapping on 3D sphere model

When above steps are done, the final content is completed. Let us run the content on a personal computer and send it to a video projector. To adjust positions of the projection, zoom function of the projector is used. Also, focus is adjusted for clear imaging.

5. USE OF THE CONTENT

Figure 5. shows an example snapshot of the content displayed on the hemisphere. The globe can be rotated with a mouse or a track ball. We confirmed that the proposed method can be used as a globe application.

Figure 5. Rendering result of texture mapping on 3D sphere model

6. SUMMARY

In this paper, a method to realize a globe using projection mapping to hemisphere was proposed and an interactive globe content was introduced.

It is supposed to be used as exhibition in musiums or educational material at school.

Currently, several enhancements are being implemented. Also, other software platforms for contents making are considered and tested.

7. REFERENCES

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