Crystal Zoetrope

Woohun Lee*, JinHa Seong
KAIST Design Media Lab.

Figure 1. (a) A crystal block with animation objects, (b) The inside of the crystal zoetrope, (c) The outside of the crystal zoetrope

1. Introduction

The modern zoetrope was invented by William Horner in the early 19th century. This simple device generates dynamic two-dimensional (2D) animations, and was widely popular until the introduction of film in the early 20 century. Even today, this optical toy can be found for sale in stores and in use in art installations. The zoetrope has been improved to display three-dimensional (3D) animations by several artists and companies, including Gregory Barsamian [1997], Stewart Dickson [2003], and Eric Dyer [2008]. The Ghibli museum displays a 3D zoetrope in the 'Bouncing Totoro,' and Pixar Animation Studios used one for 'Toy Story'. The 3D zoetrope animation provides a feeling of realism that cannot be achieved through traditional 2D animations.

3D zoetropes generally consist of hundreds of physical animation objects. Each object must be located at a particular position in space by means of a support. Therefore, most 3D zoetropes have a complicated structure and tend to be bulky. Such zoetropes are fairly large, and usually serve as an artistic installation in amusement parks or museums. Viewers must keep a distance from these zoetropes to enjoy the animation.

What if a 3D zoetrope could be made small enough to be embedded in daily objects or the environment? Smaller, 3D zoetrope animations in a table, wall, or floor would allow the infusion of unique visual entertainment into everyday contexts.

2. Implementation

We employed the Sub-Surface Laser Engraving (SSLE) technique to produce a small but elaborate animation object for building an embedded 3D zoetrope. This 3D printing technique is commonly used for making fancy souvenirs, and, in this project, 3D animation objects were engraved directly into a crystal block using the technique.

We designed hundreds of animation objects for each timeframe using 3D Studio Max software, and allocated the objects along concentric circles or a spiral curve using Maya embedded language. The modeling data was engraved into a crystal disc using an SSLE apparatus[Figure1-(a)]. The crystal block was put on a motor coaxially and it was surrounded by 20 5W power LEDs. The motor rotated at 120RPM and the power LEDs blinked on and off at 80Hz. The animation objects in the crystal block were lit by the LED lights while they were revolving around the axis of the motor. Sequential afterimages of the reflected objects produced a salient 3D animation, just like a traditional zoetrope[Figure1-(b)].

For this project, we embedded the crystal zoetrope into a table. The zoetrope was covered by an acrylic board with a thin light cut-off film intended to clarify the animation images and allow them to be seen even in the light. We attached a touch sensor array just beneath the cover to allow viewers to easily control the direction, speed, or brightness of the 3d animation by touching the zoetrope. This minimal interactivity helps people better enjoy the animation[Figure1-(c)].

3. Conclusion

We produced a miniaturized, 3D zoetrope using the SSLE technique and embedded it into a table. Imagine seeing a jellyfish swimming through your table when you visit a restaurant or a pub. Our zoetrope is different from traditional 3D zoetropes not only due to its small size and ease of production, but because using the SSLE technique allows small animation objects to be engraved in a single crystal block, eliminating the requirement to support multiple animation objects. Consequently, the technique we propose allows the animation of subtle phenomena such as fog in the sky or stars in space without difficulty.

For this study, we applied the crystal zoetrope only to a table. However, this new 3D animation technique would be equally applicable to other everyday objects or environments; lighting, walls, floors, advertising and toys could all be embedded with these zoetropes. The crystal zoetrope is a new visual medium that could make everyday objects more interactive and interesting.

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* woohun.lee@kaist.ac.kr

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