2.5 Dimensional Panoramic Viewing Technique utilizing a Cylindrical Mirror Widget

Kaori Ikematsu
Ochanomizu University
2-1-1, Otsuka, Bunkyo-ku,
Tokyo, 112-8610, Japan
g0920502@gmail.com

Mana Sasagawa
Ochanomizu University
2-1-1, Otsuka, Bunkyo-ku,
Tokyo, 112-8610, Japan
g1120520@is.ocha.ac.jp

Itiro Siio
Ochanomizu University
2-1-1, Otsuka, Bunkyo-ku,
Tokyo, 112-8610, Japan
siio@acm.org

ABSTRACT
We propose a panoramic viewing system, which applies the technique of Anamorphosis, mapping a 2D display onto a cylindrical mirror. In this system, a distorted scene image is shown on a flat panel display or tabletop surface. When a user places the cylindrical mirror on the display, the original image appears on the cylindrical mirror. By simply rotating the cylinder, a user can decide the direction to walk-through in VR world.

Author Keywords
Anamorphosis; Tangible UIs; Phicon

ACM Classification Keywords
H.5.2 User Interfaces: Input devices and strategies

INTRODUCTION
In [2], Hiroshi Ishii defined a Tangible User Interface (TUI) as a direct manipulation of digital information. Recently, creation of various battery-less TUIs that are used on a tabletop surface has risen dramatically. Focusing on TUIs that display information on their own surfaces, Halskov augmented a tangible widget with a three dimensional projection mapping[1]. In [3], translucent tangible widgets transport information on the top of the surface from an underlying display. These widgets have a specific appearance associated with a logical object or specialized functions for enhanced specificity. However, the contents appear on the surfaces are limited. For example, a human face shaped widget[3] is unsuitable for images other than facial expression images. We demonstrated Anamorphicons[4] as a battery-less passive input-output TUI. This application consists of a tangible cylindrical mirror and capacitive touch pens. The technique enables a user to interact with an image projected on a physical icon (phicon), by applying the concept of the mirror anamorphosis to a multi touch display and mirror device. The cylindrical mirror widget allows the user to view the pseudo stereoscopic images.

Permission to make digital or hard copies of part or all of this work for personal or classroom use is granted without fee provided that copies are not made or distributed for profit or commercial advantage and that copies bear this notice and the full citation on the first page. Copyrights for third-party components of this work must be honored. For all other uses, contact the owner/author(s). Copyright is held by the author/owner(s).

UIST'16 Adjunct, October 16–19, 2016, Tokyo, Japan.
ACM ISBN 978-1-4503-4531-6/16/10.
http://dx.doi.org/10.1145/2984751.2985737

Figure 1. Anamorphicons, tangible user interface method using anamorphosis.

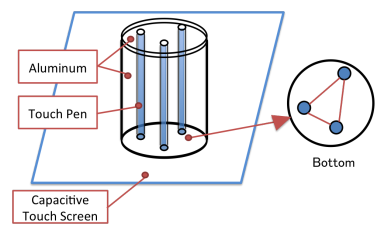

Figure 2. The system detects an asymmetric polygon formed by the tip of touch pens on the bottom of the cylinder. It computes and follows the cylinder rotation of the angles.

In this paper, we present a new panoramic viewing system using Anamorphicons. When a user places the cylinder on the center of the display, 360 degrees panoramic image will appear on its surface. We introduced the concept of a surrogate for this application. That is, the Anamorphicons placed on the display becomes an agent of the user, and the scenery from the viewpoint of the Aramorphicons agent is exhibited on the mirror surface.

ANAMORPHICONS
Anamorphosis is a painting technique that draws distorted images (Fig.1 left). The viewers are required to use special devices or to adopt a specific perspective to recognize the undistorted image. It is an optical phenomenon with the property that when a curved mirror reflects a picture on a flat surface, the image of the picture reflected in the mirror looks distorted to the observer. It enables stereoscopic vision based on binocular parallax. We have implemented an interactive cylindrical mirror anamorphosis using a flatpanel display and a cylindrical mirror placed on the display. We named our cylindrical mirror device "Anamorphicons" by combining anamorphosis and phicons (physical icons).

Figure 3. A original panoramic picture is converted to a distorted image for Anamorphicons by using polar coordinates filter in the application.

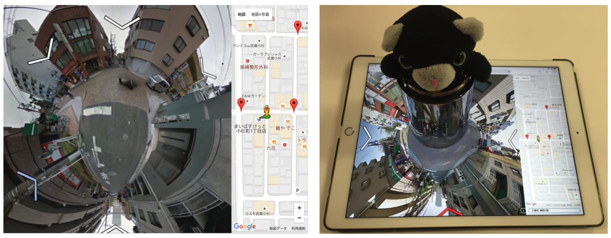

Figure 4. (Left) A screen shot of the distorted panoramic image and map view on the iPad. (Right) A user can decide the direction to walk-through simply by rotating the Anamorphicons.

IMPLEMENTATION

We have implemented an Anamorphicon system using an iPad as a display and detector for our cylindrical mirror. The system supports interactively generates content when browsing a 360 degree view of a scene. It was implemented using javascript, HTML5 and to get panoramic images, we use Google Maps API[1]. To detect the coordinates and rotation of the cylindrical mirror placed on the iPad, we placed three touch pens inside a reflective cylinder, on opposite sides, all of which touched the bottom, as illustrated in Fig.2. The top side of the cylindrical mirror is consists of aluminum. The touch pens and the aluminum board are connected by electric leads to detect the user's manipulation. Three touch pens are arranged in an asymmetric fashion, then the triangle formed by tips of the touch pens are recognized as a unique pattern. With this structure, as the user touches the aluminum part, the iPad application is able to detect the coordinates of three points from the touch pens. By computing the arrangement of the three touch pens, the algorithm can determine the position of the cylinder. It can also detect the rotation of the cylinder relative to the position of the three touch pens. Depending on the rotation angle, direction to walk-through the VR contents is decided. The application converts panoramic pictures of sceneries (Fig.3). It changes the image shown on the iPad display according to the current position on the map. When a user is rotating the physical cylindrical mirror using his/her hand, an arrow image on sceneries from a certain angle is shown. It indicates the direction to travel.

SYSTEM OVERVIEW

We have developed a map based panoramic viewer that provides a 360 degrees panoramic image from specified positions on the map view. In the previous work, Anamorphicons represents a virtual item itself. In this work, it represents 360 degree sceneries surround an observation point. When we adapt the panoramic scenery image to the cylindrical mirror and view from the outside of the cylinder, an appropriate mental model is required for the Anamorphicons. Our application employs a physical avatar, that is, the Anamorphicons represent a surrogate of a user. For ease in understanding the model, we attached a figure to the top of the Anamorphicons (Fig.4 right). This figure will make it clear that the reflected scenery corresponds to the viewpoint of the doll position on the mirror. Fig.4 the application window displayed on the screen. The right side window contains the map area while the left side contains the distorted image of the sceneries. In the map area, a pictogram indicates a current position of a panoramic view. When a user drags a pictogram to any location, corresponding viewing images will appear on the left side area. Then, as a user places the pictogram at any place, the anamorphic image on the screen is reflected on the cylinder surface that corrects the distorted image so that the image on the cylinder looks normal to the user. The application translates the angle of the direction of the view from the current position by utilizing the pattern generated by the touch pens. Fig.5 shows snapshots of the application. A image of white arrows indicates paths for next panoramic view exists in the direction. When a user put a cylinder on the iPad, blue arrow image is overlaid (Fig.5 left) on the panoramic image. It moves according to the cylinder rotation angle. When a user rotates the Anamorphicons to move the blue arrow to white arrow direction, the blue arrow turns to red (Fig.5 right). Then a user can move to next panoramic view by touching the screen.

[1]https://developers.google.com/maps/

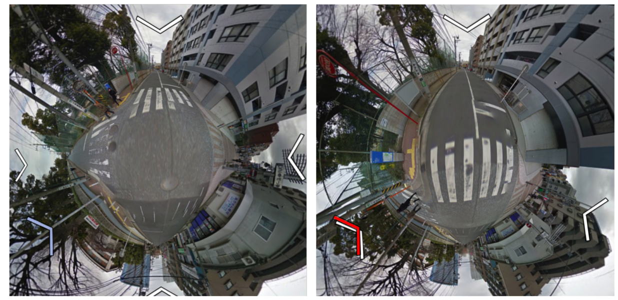

Figure 5. White arrows indicates a direction to next panoramic view. The colored arrow indicates whether a path to the next view exists (Red arrow) or not (Blue arrow) in current direction.

CONCLUSION AND FUTURE WORK

In this paper, we demonstrated a Anamorphicon system, which provides interaction between the user and the image on a cylinder by detecting the rotation of the cylinder. We are planning to conduct experiments to compare the Anamorphicons panoramic viewer to the Google street view.

REFERENCES

1. Dalsgaard, P., and Halskov, K. Tangible 3d tabletops: Combining tangible tabletop interaction and 3d projection. In *Proc. NordiCHI '12*, ACM (2012), 109–118.
2. Ishii, H., and Ullmer, B. Tangible bits: towards seamless interfaces between people, bits and atoms. In *Proc. CHI'97* (1997), 234–241.
3. Sato, T., Mamiya, H., Koike, H., and Fukuchi, K. Photoelastictouch: Transparent rubbery tangible interface using an lcd and photoelasticity. In *Proc. UIST'97*, ACM (2009), 43–50.
4. Suga, C., and Siio, I. Anamorphicons: An extended display with a cylindrical mirror. In *Proc. ITS'11*, ACM (2011), 242–243.