OmniLantern: A Portable Omnidirectional Projector-Camera System in the Shape of Lantern

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Abstract. We present a lantern-like projector-camera system named OmniLantern, which is composed of an ultra-wide-angle lens and a projector-camera unit. Unlike other existing projector-camera systems, OmniLantern can detect the objects and project to all directions with one projector-camera unit. We introduced the design concept of the OmniLantern firstly. Then we showed our implementation of the hardware and the software. Finally, we developed some applications of this system and discussed the limitations and future work.

1 Introduction

There are a lot of ways of enhancing the users' vision experience using a wide-angle lens. For instance, Maeda et al.[1] show a tabletop system with an omnidirectional lens and Kasahara's HeadLight[2] is a wearable projector system with a large field-of-view. However, the existing works have limitations. Maeda's work is set under the table and it is hard to be moved. HeadLight is designed for the first-person perspective using and does not support multiple people using.

That's why we present OmniLantern, a novel projector-camera system with an omnidirectional lens. We combined the projector, camera, and wide-angle lens together so that OmniLantern can be a movable system. The users can take the OmniLantern walk around, share the information with others, or put it wherever they want, which is impossible with the normal projector-camera system.

Considering this system is a novel system and the users may be confused about how to use it, we also show a lantern metaphor for it. The appearance of the OmniLantern likes a lantern, and it can be used as a lantern as well.

2 Implementation

We developed the design of the OmniLantern shown in Figure 1. OmniLantern is composed of a 37mm Opteka 0.3X ultra fish eye lens, a small LB-UH6CB laser projector, a CM3-U3-13Y3C-S-BD Chameleon3 camera, a half-mirror from Edmund Optics with reflection-transmission ratio 20/80, and the 3D-printed case.

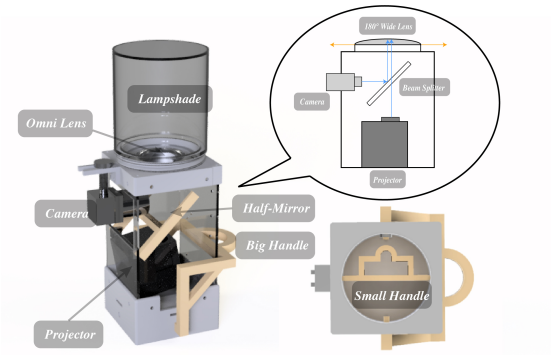

Figure 1. Hardware composition and principle

To make the users easy to understand how to use OmniLantern, we designed two special parts. Firstly, we added a lampshade to the OmniLantern, like the lampshade of the real lantern. When OmniLantern is equipped with the lampshade, OmniLantern is a small size cylindrical display. On the other hand, when the lampshade is moved, contents can be projected to other surfaces with AR markers. These two different modes make the system more flexible to be used.

Secondly, in order to realize the portable system, we designed two different handles for the system. The bigger handle is used for grabbing OmniLantern. Users can easily hold the handle and walk around. The smaller handle is for hanging OmniLantern on the top. Using these handles can let the users understand the usage of a novel interactive device naturally. Figure 2

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shows the prototype of OmniLantern.

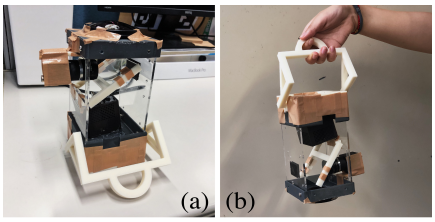

Figure 2. Prototype of OmniLantern, users can put it on table(a) or hold it(b)

For each target of the projection surface, we attached an AR marker on it, so that the markers will tell the projection content and surface size. We detected the pose of the markers from the image, and use marker's pose to distort the projection content, and project it to the corresponding positions.

3 Application

We discuss some applications that can utilize the unique advantages of the OmniLantern in this part, including four basic modes and four extra functions.

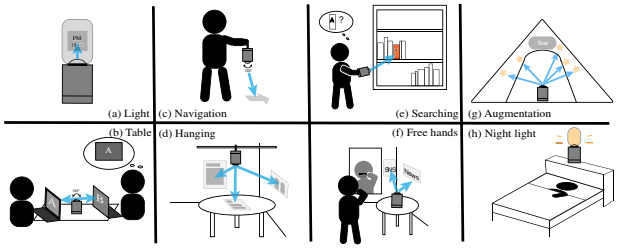

Figure 3. Shows the basic modes from (a) to (d) and extended functions from (e) to (h)

3.1 Basic modes

The first mode is called Light Mode. When the users put on the lampshade, OmniLantern is a cylindrical display that can be placed on the table. It shows some necessary information for users such as time or to-do list or be a normal light.

What's more, users can take off the lampshade and put it on the table, which is called Table Mode. For example, when people are working with computers opposite each other, OmniLantern projects the display content on the back of the computer. This mode can be used in teamwork or meeting.

In the Navigation Mode, when users hold the handle of the lantern and walk, OmniLantern is able to project the navigation message onto any suitable surface around the user such as floor or wall as shown in Figure 3(c).

Figure 3(d) is Hanging Mode, users can hang the OmniLantern on the top and project contents on the table, floor or the walls around. They only use one projector and can realize spatial augmentation.

3.2 Extended function

In addition to the mentioned modes, there are many other functions based on the basic modes as shown in Figure 3(e) to Figure 3(h), such as highlights the target for searching the things, provides the SNS or entertainment content when users' hands are busy, augments small space, and works as night light.

4 Discussion and Conclusion

We present OmniLantern, a novel device that can realize the spatial projection with one projector-camera unit. This design could solve the problems of multiple camera calibration and can also make the whole system portable.

In our current prototype, we used AR markers for determining the pose and location of the projected content, which is unnatural for users. To overcome this problem, we could use invisible markers with infrared absorbing ink and IR camera.

What's more, as a portable system, we are going to add the positioning functions to OmniLantern, so that it can decide which mode to use based on the current location.

Last but not least, OmniLantern needs more interactive ways such as gesture interaction, we are going to develop simple gestures for the users to operate the system.

References

[1] Maeda, K., Piekenbrock, M., Sato, T., & Koike, H. (2018, November). A Tabletop System Using an Omnidirectional Projector-Camera. In *Proceedings of the 2018 ACM International Conference on Interactive Surfaces and Spaces* (pp. 311-314). ACM.

[2] Kasahara, S. (2018, August). Headlight: egocentric visual augmentation by wearable wide projector. In *ACM SIGGRAPH 2018 Emerging Technologies* (p. 10). ACM.