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携帯プロジェクタを用いた空間型 AR 提示

Spatial AR Representation Using Portable Projector

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Abstract: This paper describes the development of portable three-dimensional information projection system that uses spatial augmented reality technology. This system aims at acquiring information directly from the object, by illuminating the object using the portable projector, and representing the three-dimensional information on it. The ability of the prototype system to present the three-dimensional information was experimentally measured, and the capability and the limitation of this system were shown. In this study, this system was applied to the room management system and the effectiveness was evaluated.

Keywords: *portable projector, ARToolKit, Augmented Reality.*

1. Introduction

In the current information society, a lot of information is generated and accumulated in various fields. However, it is difficult for the user to get necessary information efficiently.

Therefore, it is important to establish a quick and easy way to get the necessary information, when and where it is needed. For example, it is expected that when the user want to know the structure of the building, the building itself output the information, and when the user want to know the schedule of the meeting rooms, the room itself present it. In order to achieve this kind of information access method, the portable information projection system has been developed. This system can retrieve the necessary information from the database using the location key, and project it onto the object (Figure 1).

Figure 1: Information access using location key.

In this study, the prototype system that projects three-dimensional information onto the object as well as two-dimensional information such as text and image was produced. Especially, the basic capability of representing the three-dimensional information using the portable projection system was examined, to demonstrate the effectiveness of the proposed system.

2. Portable Three-dimensional Information Projection System

In this study, we developed a portable projection system using spatial AR technology, as a device of extracting the necessary information from the object according to the situation. Recent projector has become small, light and low price, the users can bring it attached with a mobile phone and digital camera in daily life. In addition, the projector has functions not only to output information but also to point at the target, and the users can share the projected information with the illumination light in the real space.

As related works using the portable projector, SixthSense [1] at MIT, HipMountProjector [2] at Osaka University, and Twinkle [3] at Keio University have been developed. These systems are used for the purpose of entertainment and new interfaces, and the outputted information is a two-dimensional image. On the other hand, this study aims at applying the portable projector to construct an information access device which can output three-dimensional information. Though the portable projector is currently used to output two-dimensional information such as the text and image, it can be expected to present various information that includes three-dimensional image or augmented reality scene as a next generation display device. In this paper, in order to realize this consept, a prototype system which can output three-dimensional information in the real space using the AR technique was developed.

3. Prototype System

In this study, a portable three-dimensional information projection system was constructed by combining lap top PC (Sony, VAIO Type-P), USB camera (logicool, Qcam Pro for Notebooks QCAM-200V), and portable LED projector (ADTEC, AD-MP15A), as shown in Figure 2.

In addition, DLP projector BENQ MP624 was also used for the comparative experiments, because it is difficult to recognize the visual information accurately in the lighting condition of the portable projector.

As a software tool to generate the three-dimensional image projected onto the object, ARToolKit is used [4]. In order to project the three-dimensional image accurately in the real space, the positional relationship between the camera and projector must be determined. In this system, since the projector is attached at the left side of the camera lens, the position and orientation of the projector are calculated by adding the offset to the position and orientation of the camera. Thus, in this method, the system can be used as if the marker is recognized by the projector's light instead of the camera.

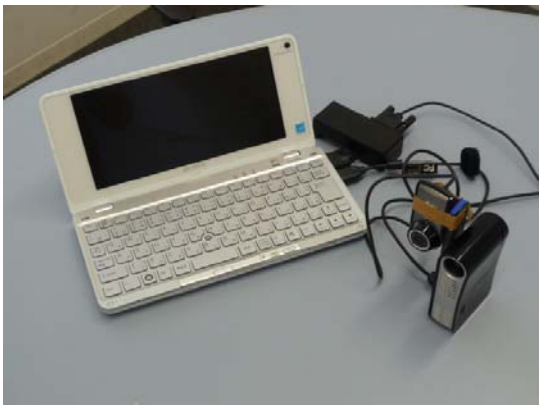

Figure2: Portable three-dimensional information projection system

4. Evaluation of the Current System

In this system, though the projector itself does not have a capability to present a stereoscopic image, the three-dimensional AR representation based on the motion parallax can be performed by generating an image according to the moving projector's position. Figure 3 shows the example of projecting the three-dimensional image of the configuration of desks and chairs onto the door of the meeting room.

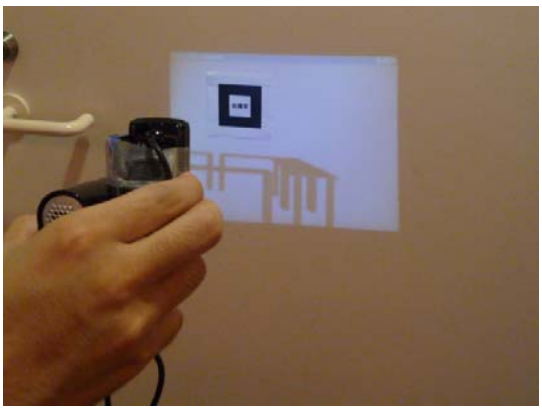

Figure3: Spatial AR representation using projection image

In this study, the basis capability of the system to represent the three-dimensional information by moving the projector was experimentally measured. When the portable projector is used, two kinds of different ways such as moving the view position along with the projector or moving only the projector by the hand can be used depending on the size of the displayed image. In the experiment, the difference of the three-dimensional sensation felt by the subjects were measured when the size of the displayed image and the method of moving projector were changed. Moreover, since the brightness of the portable LED projector is not high enough, the DLP projector was also used to compare the three-dimensional sensation felt from the projected image (Figure 4).

From the result, the brightness of the projector, the size of the displayed image, and the movement of the view position of the subjects have significant difference on the three-dimensional sensation felt by the subjects.

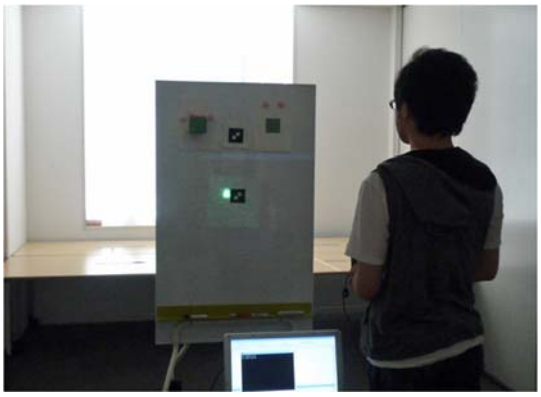

Figure 4: Experiment on measuring three-dimensional sensation

5. Conclusions and Future Work

In this study, a prototype system that represents three-dimensional information using the portable projector was developed. This system provides intuitive and quick access to the information, and proposes a new way of using the projector. Recently, since the small and light projectors have been mounted on the mobile devices such as the cellular phone and digital camera, the establishment of a new method of using the projector is expected. Furthermore, it has become more and more important to use the three-dimensional information effectively according to the advancement of the three-dimensional display systems.

Future work will include integrating various sensing technologies such as the marker and the wireless LAN as well as improving the accuracy of the sensor and display technologies.

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