Wearable scanning laser projector (WSLP) for augmenting shared space

Maeda T. *
NTT Communication Science Laboratories

Ando H.†
NTT Communication Science Laboratories

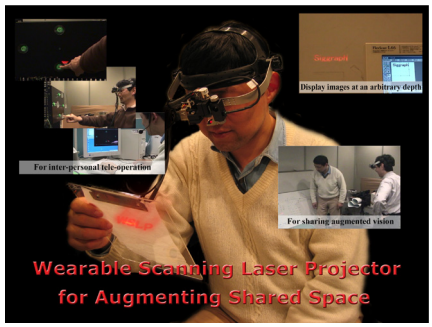

Figure 1: Wearable scanning laser projector (WSLP)

Abstract

A novel wearable apparatus was developed for ubiquitous and augmented reality. The head-mounted projection system uses rapidly scanned lasers to display information directly onto any object using the object as a "projection screen". The wearer's augmented vision can be shared by his colleagues, both nearby and in remote locations.

Keywords: augmented reality, laser projection, wearables

1 Introduction

Augmented Reality (AR) is a well-known domain of technology that enhances visual information in the real world with computer-generated images. Traditionally, this enhancement was visible only to a single user wearing a see-through head-mounted-display, and could not be shared with nearby friends and colleagues who were not wearing similar devices. To usher the augmented reality paradigm into the era of ubiquitous computing, we developed a novel wearable visual display that can be experienced by any number of people. This head-mounted projection system uses rapidly scanned lasers to display information directly onto any object, effectively using it as a "projection screen". Using the system, the wearer's augmented vision can be shared by his colleagues, both nearby and in remote locations.

2 Exposition

AR uses an Optical See-Through Head Mounted Display (HMD) in many cases. Because the image in previous HMD's had been projected onto a specific depth in focus, it was difficult to observe both the object and the image corresponding to it at the same time when they exist at different depths. In this device, the center of the mirrors scanning the laser beam is aligned conjugate to the center of the wearer's eye. As a result, the light spot of the beam is always observed in the same direction of the sight on any depth of surface. Through this arrangement, the wearable device can not only display stable images onto objects at an arbitrary depth but the wearer can also observe images both on and around the objects with uniform focusing, which is notoriously difficult to achieve with a conventional see-through Head Mounted Display, because they project images to a specific depth, and it is difficult to observe the object and the image corresponding to it at the same time when they exist at different depths. The composition of a Head Mounted Projector by Galvano-mirror scanning devices has many advantages over previous HMD's. For example, it could compensate the projection axle for head movement at a high speed. Moreover, this system is particularly useful for performing interpersonal tele-operation tasks. A camera worn by a mobile user transmits video to a remote operator, who augments the wearer's shared environment with text and images through the wearable laser-based projection system. When the operator shares the same display space and field of view as the wearer, instructions may be understood more intuitively, and operations become less prone to error as a result. Using the system, the wearer's augmented vision can be shared by his colleagues, both nearby and in remote locations. This realization enhances life through the mutual sharing of a viewpoint and augmented visual information, which successfully achieves the concept of "Open augmented reality."

3 Conclusion

The ultimate target is to engineer the device to weigh 100g or less. At the present stage, the prospect of making it 150g or less is readily attainable. Moreover, we wish for this device to present full color images by RGB laser beam sources. Both the domains of Wearable computing and Ubiquitous computing will directly benefit from the future of this work. Because this device has a structure similar to a bar-code reader, it is readily used in a ubiquitous computing setting. Moreover, it corresponds to the high-speed realignment needed when wearable display is applied as augmented reality technology. Using the system, the wearer's augmented vision can be shared by his colleagues, both nearby and in remote locations. This realization enhances life through the mutual sharing of a viewpoint and augmented visual information, which successfully achieves the concept of "Open augmented reality."

M. Inami, N. Kawakami, D. Sekiguchi, Y. Yanagida, T. Maeda, S. Tachi: Visuo-Haptic Display Using Head-Mounted Projector, Proceedings of the IEEE Virtual Reality 2000, pp. 233-240, New Brunswick, New Jersey, USA (2000.3)

T. Maeda, H. Ando, M. Sugimoto, J. Watanabe, T. Miki: Wearable Robotics as a Behavioral Interface - The Study of the Parasitic Humanoid, Proceedings of Sixth International Symposium on Wearable Computers, pp145-151, Seattle, Washington, USA (2002.10)

N. D. Glossop*, Z. Wang: Laser projection augmented reality system for computer- assisted surgery, International Congress Series 1256, pp65- 71, Elsevier Science (2003)

C. Aimone, A. Marjan, S. Mann: EyeTap Video-Based Featureless Projective Motion Estimation Assisted by Gyroscopic Tracking, Proceedings of Sixth International Symposium on Wearable Computers, pp90-100, Seattle, Washington, USA (2002.10)

*e-mail:maeda@avg.brl.ntt.co.jp
†e-mail:hide@avg.brl.ntt.co.jp