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Author	田井中, 麻都佳(Tainaka, Madoka)
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Styles of communication being transformed by augmented reality

What is AR that superposes virtual environment upon real environment?

Recent years have seen application of Augmented Reality becoming increasingly popular along with the keyword "AR" in a wide range of fields such as smart phone applications, games, and advertising/sales promotional tools. Here, let's have a look at several concrete examples to overview the initiatives being developed by Assistant Professor Maki Sugimoto who pioneers the development of new styles of AR and pursues research into next-generation communication tools.

Spread of AR technology is accelerating in pace with its ever-expanding application to entertainment and advertisement.

Augmented Reality (AR) is the research field Dr. Sugimoto of the Department of Information and Computer Science is currently dedicated to. AR is a field deriving from Virtual Reality (VR) with which we are familiar in SF movies and games.

"While VR studies mainly aim to create sensory information that immerses users into a virtual environment built within the computer, AR aims to augment sensory information by superposing information from the computer upon that of our actual living environment (see Fig. 1 (Right)). In other words, by superposing a computer-created virtual environment upon the actual world in real time, AR allows us to access the virtual environment in a more natural way," as Dr. Sugimoto outlines his field of study.

A recent momentum that aroused interest in AR among the general public was the impact of the animation "Coil – A Circle of Children" televised on NHK (Japan Broadcasting Corporation) in 2007. The animation depicts scenes of children experiencing AR in their daily lives using a compact HMD (Head Mounted Display).

Meanwhile, "ARToolKit" software, developed by Professor Hirokazu Kato of Nara Institute of Science and Technology, is also worthy of special mention as having contributed to the spread of AR. It can make a virtual character or object appear on the screen after camera-scanning a pattern printed on a sheet of paper. Given its availability as an open source, many character animations produced by means of ARToolKit have been contributed to video-sharing websites, while video games and advertising/sales promotional tools based on similar technologies are also spreading lately.

"For example, there is a tool capable of drawing a computer graphics model of a vehicle's body on the screen if you hold the vehicle's promotional pamphlet over the camera, allowing you to confirm the vehicle's running state or internal structure. Competitive games combining a card game and CG are also rising in popularity. Thus, AR has now become a vital technology indispensable to advertising and entertainment."

Fig.1 Human-computer interfaces taking physical presence and spatiality into account

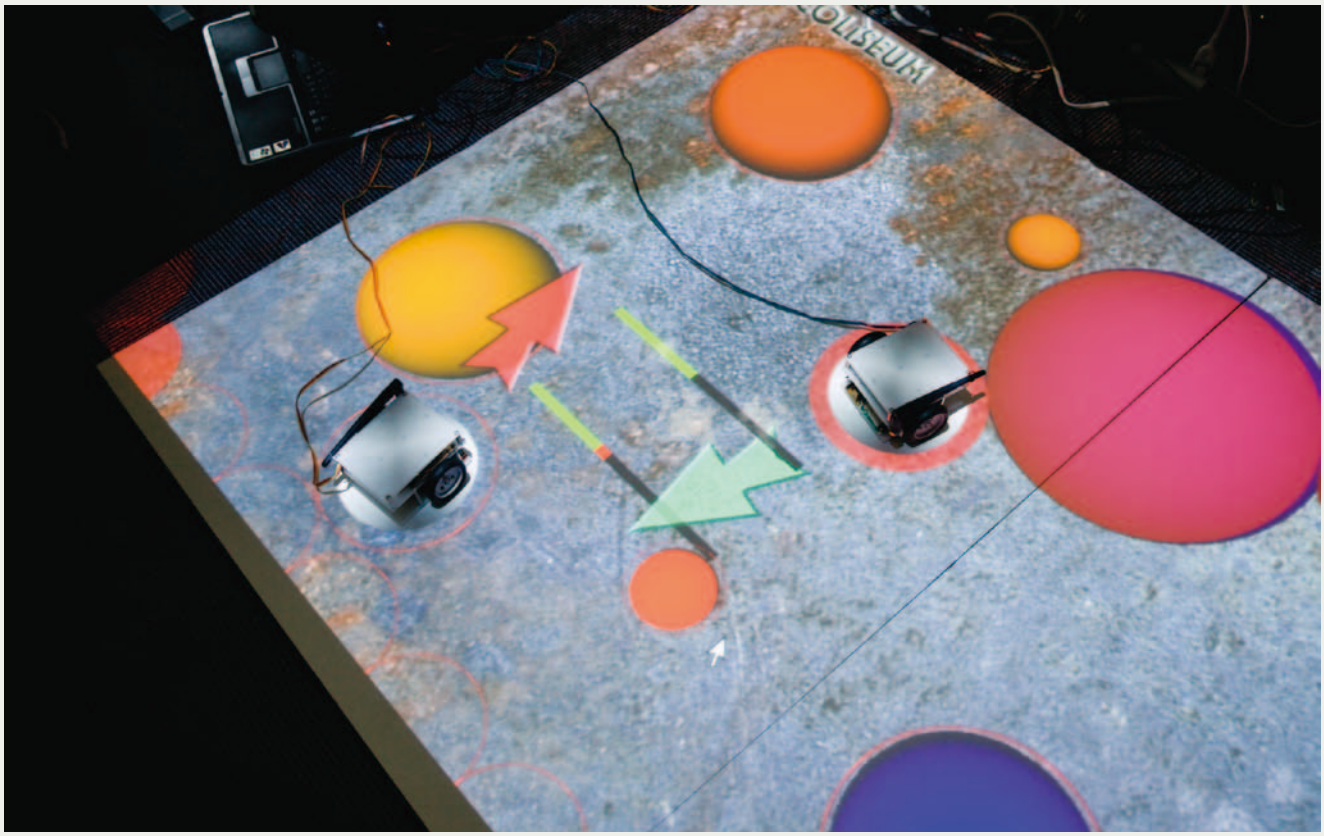
(Left) With this "Stickable Bear" interface, the bear-shaped robots of a size fitting in the palm of a hand support communication via gestures. The bear shape was created using a 3D printer.
(Right) This is an attempt to realize markerless tracking of location and/or attitude using a range image camera in a Spatial Augmented Reality environment. A texture projected by the projector follows a three-dimensional shape.

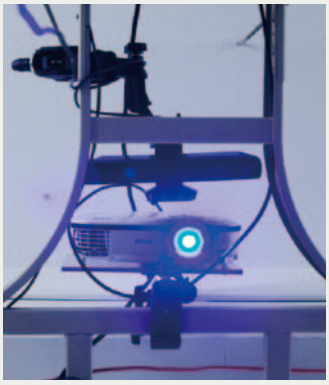
Not only on a display screen but fusion in a real environment as well

You may talk about "AR" broadly, but its techniques vary widely. Currently most popular is a system known as "video see-through." Like the above-mentioned ARToolKit, the video see-through system realizes AR by superposing on the display the information created on the computer upon images taken by a camera. Meanwhile, the system known as "optical see-through" uses a transmissive display and is equipped with a half mirror and a see-through-type HMD. It is capable of superposing CG on real images that are optically visible. Furthermore, the system known as "spatial AR" can transform a real environment by projecting virtual images onto the real environment. The "Projection Mapping" event held in the newly renovated Tokyo Station Building in 2012 is a typical example of spatial AR.

"AR techniques are also very useful in work support. Application of AR to work support has already begun – for example, a patient's excision area can be clearly indicated by superposing a pre-photographed CT or MRI image onto his or her affected part at the time of surgical operation. Thanks to the recent spread of smart phones and personal digital assistants (PDA), the number of AR-based services easily available to general consumers is increasing. "Layar" combining location data and a camera is a fine example"

Dr. Sugimoto continues, "With the





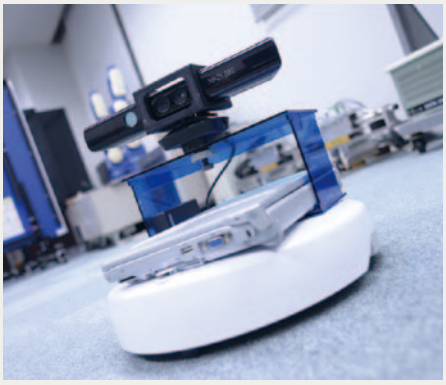


Fig. 2 Robots acting in harmony with AR environment

(Above) Based on the concept of Display-Based Computing, the entertainment environment "Augmented Coliseum" is capable of measuring and controlling by means of a projector and optical sensors mounted on vehicle-type robots.
(Below left) This is a projection system for building up a spatial AR environment. Collaboration with robots has been made easy by exerting ingenuity on projection patterns.
(Below right) This is a remote-controllable vehicle-type robot based on the video see-through AR technology. It is possible to control the robot while confirming future predictive images that have taken into account the interaction between the surrounding environment and the robot.

recent spread of AR, it is now perceived as a broader technology that can not only augment sensory information on the display screen but can also directly transform the real environment itself. This makes AR studies all the more interesting and worthwhile."

Measuring and controlling robot movements using an optical ruler

Dr. Sugimoto is currently working on the development of a dynamic type of spatial AR, in which visual information is projected onto the real environment.

He adds, "By using devices such as projectors and robots, I'm trying to project information contained in the computer directly onto a real environment."

"For example, in the 'Augmented Coliseum' competitive shooting game using vehicle-type robots, robot movements are controlled by identifying accurate locations and attitudes of the robots mounted with optical sensors that can read fiducial images projected from the projector (see Fig. 2(Above)). By dynamically projecting a so-to-speak "optical ruler," the system realizes a highly accurate AR environment."

The greatest merit of this system is that it is possible to identify highly accurate locations of the robots only by using information read by the five robot-mounted sensors. Compared with common image sensors, the system allows computer computational complexity to be reduced significantly while also making it possible to move the robots in real time.

Dr. Sugimoto is also proceeding with a research project to achieve real-time synchronization, in an AR environment, of movements of a robot at hand with those of a robot in a remote location.

"Suppose you are doing a desk study to determine the arrangement of things inside a building. In this case, if you moved an object in front of you, a similar object in front of a person in a remote location would move in synchronization. This surely will enhance your sense of reality."

In this relation, he is also engaged in the development of a communication tool that allows an optical sensor mounted on a compact bear-shaped robot to read information on the computer screen and make various gestures in accordance with the information (see Fig. 1(Left)).

"What I want to realize by using augmented reality is flexible interface between humans and information. By presenting information with spatiality while setting much value on physical nature in the real environment, I would like to give concrete shape to abstracted information, thus contributing to smoother communication among people," concludes Dr. Sugimoto.

(Reporter & text writer : Madoka Tainaka)