

# Object information visualization and comparison technique using augmented reality

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## Abstract

It is important to understand information of working object. Especially, effective work is possible by understanding information which the user is hard to see. One technique to give the user its information is that the system displays numeric information. However, the efficiency of work might not go up so much because it is difficult to compare information with two or more objects overall in such a technique. Moreover, only understanding rough information is enough for working.

To cope with these problems, we use picture signs for displaying information of objects. The user can understand information of objects quickly from the states of picture signs. The user can also understand the whole information by comparing picture signs of objects. Moreover, the user can interact with information and the system can display it that he/she wants to know.

*keywords:* Ubiquitous computing, Information visualization, Cybernetics, Finger interaction

## 1 INTRODUCTION

If the user can know information of an object before doing various works, the efficiency of work can be raised. However, it is difficult to understand the weight and the state of the object by watching because information that the user can obtain from eyes is limited. Augmented reality (AR), which synthesizes information to a real environment as an imaginary object, is one method for adding information that cannot be confirmed only by the user's eyes[1, 2, 3]. However, it is difficult for the user to compare information (weight, contents of the object, etc.) of objects when the system displays it as a numerical value or text. Especially, it takes many times to compare objects comprehensively from much information of many objects, because the user has to do it many times between two or three objects.

To cope with the problems, we expressed information as “picture signs” such as the effect lines and the effect icons used by the cartoon, animation, and so on. The displayed picture signs are different by



Figure 1: Display of information using numeric value



Figure 2: Display of information using picture signs

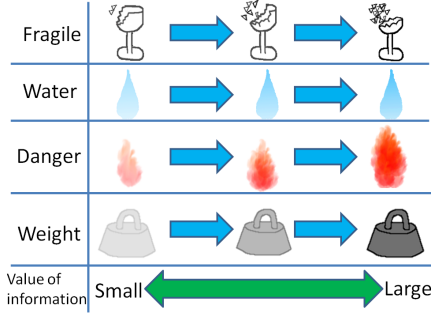


Figure 3: Variation of picture signs

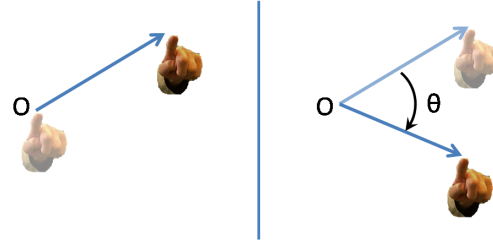


Figure 4: hand gesture: (left) moving to a direction, (right) rotation

kinds or values of the information of the object. Therefore, the user can get rough information quickly by changing the parameters of picture signs, such as the kind, the size, and so on. In our research, we display information, which the user cannot obtain from their eyes, as picture signs. The user can get information of an object from the states of picture signs and also compare information between objects easily. Moreover, the user can interact (e.g. changing displayed information, setting range of value, and so on) with information by the gesture using the movement of fingertip.

## 2 INFORMATION VISUALIZATION USING PICTURE SIGN

One of the information visualization technique is that all information, which the user is hard to see (weight, fragile, and so on), expresses as numerics and displays them directly like Figure 1. This visualization technique can understand information on one object easily. However, when the user compares two objects, it takes many time, because he/she has to read and to compare information of them many times. Moreover, when the user compares more than three objects, it takes more time for the comparison, because it is difficult to do the whole information at a time in numeric visualization.

In our method, all information is expressed as picture signs which corresponds to it, and overlaid item near the object as Figure 2. Figure 2 is shown “Dangerous”, “Fragile”, “Liquid”, and “Weight”. These picture signs are overlaid near the object which has the information. Each information is expressed numerically beforehand according to property of the object, and picture signs change depending on its numerical value.

Picture signs are displayed by changing parameters such as transparency, size, number, and so on. Changing parameters are different in the kind of displayed information. Basically, when the value of information is large, its picture sign is displayed more clearly, and bigger. The number of components of a picture sign is also large. Figure 3 is an example of the change in the display of picture signs according to the value of information. In case of the picture sign of weight, when the value of it become large, the displayed picture signs is more clearly as shown in Figure 3. In case of the picture sign of fragile, transparency is same, but the shape of the glass and the number of piece of it are changed.

Using picture signs, it is hard to understand a detailed information, but the user can get a rough information at first glance. Moreover, the user can do rough comparison of the information of each object easily by looking over picture signs, because he/she only has to compare the difference of the display of them. For example, when the user looks over the display of Figure 2, he/she can understand that the object under the left is hard to carry (heavy, danger, and fragile).

### 2.1 Comparison using picture signs

The comparison of information between objects is done by comparing the displayed picture signs mutually. When the user compares the same kind of picture signs, he/she judges it using the number, the

size, the transparency of it. If the displays of them are almost same, the user can judge that the values of the information of each object are same.

The user can also compare the whole information quickly by looking over picture signs of all objects. Comparing the whole information, the user can judge which object needs many people, or which object is easy to carry. In case of Figure 2, the user can judge that the left below object needs many people and they should carry it with care. Moreover, the user can judge that the object in upper left is easy to carry by one person.

## 2.2 Change in displayed information

In our technique, the information of one object is basically displayed directly as picture signs. However, if the system always displays all picture signs, the understandability of information might decrease, because the user might take longer time for understanding information. We allowed the user to compare without displaying needless information of them by setting the range of displayed information. The user can limit the displayed picture signs by changing the range (the upper/lower value) and the kinds of displaying information.

When the user sets the range, picture signs which are out of the range are not displayed. When the user sets picture signs which he/she does not want to display, they are always hidden, even if they were in the range. The display of picture signs changes dynamically depending on the value of information of the object, and the range. Therefore, the display of picture signs changes as the range changes.

## 2.3 Interaction with the information

The user can interact with information such as changing displayed information and the range by using hand gesture which uses the movement of the fingertip[4]. The user can select and execute menus according to the trajectory of the movement of fingertip. Moreover, the user can change the value of the range (the upper/lower value) continuously by the trajectory like drawing a circle.

The menu interface has “main menus” , and each main menu has some “submenus”. When the user moves his/her fingertip to the breast, main menus like the Figure 5(a) is appeared. The menu interface is overlaid on the user’s view. When the user moves his/her fingertip like the left of Figure 4, the system judges the direction of the movement, and the system expands submenus that corresponds in the direction like Figure 5(b). Then, when the user moves his/her fingertip like the right of Figure 4, submenus rotates and the selected submenu is changed (see Figure 5(c)).

The user can switch show (hide) picture signs (weight, fragile, liquid, danger), change the range (the upper/lower value), and do reset of the display. The system displays all picture signs and sets the display range 0 to 100, when the user reset the display.

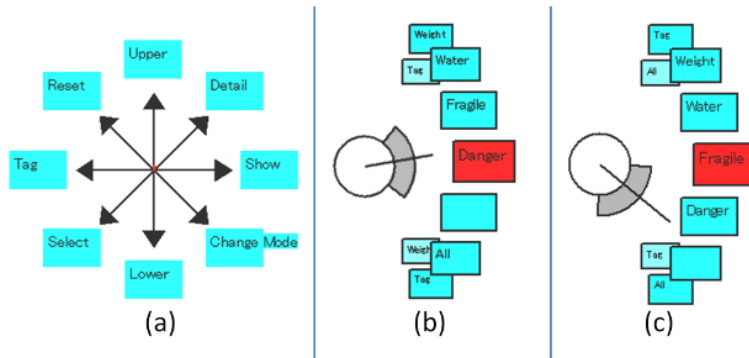


Figure 5: Menu interface for gesture: (a) Initial state (showing main menus), (b) Extending submenus, (c) Rotating submenus

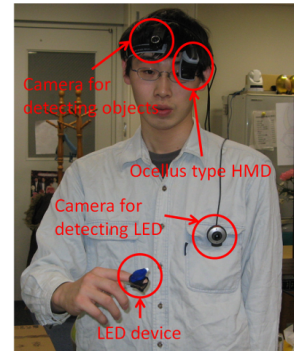


Figure 6: System setting

### 3 SYSTEM IMPLEMENTATION

The composition of our system is shown in Figure 6. We use two cameras. One is for detecting objects, and the other is for tracking of the movement of the user's fingertip. Displaying information on recognized objects is shown through the ocellus type HMD. All processes (detection, tracking, and display) are done by one portable computer.

We use AR Toolkit for recognizing of objects and detecting the positions of them. Each object has a marker, and the system detects these markers and calculates the position according to it. The system displays picture signs near the object using OpenGL. About detection of fingertip, the user puts his/her fingertip on the LED device, and the system detects its light.

When the user stays the LED device near the breast for a while, the menu interface is overlaid on the HMD. When the system cannot detect LED device for a while, it hides the menu interface. As for movement of the fingertip, when it moves the constant distance from the resting position, the system detects the direction of the movement and extends the submenus according to the direction. Then, if the LED device rotates more than the constant degree, the system changes the selected submenu. When the LED device moves back to the position, where the user started the menu selection, the system executes the selected submenus and displays main menus (Figure 5(a)).

As for the continuous operation using rotation (see the right of Figure 4), when the LED device moves over the constant distance from the position where the user finished a menu selection, the system starts its operation. The system changes a value according to the direction of rotation (clockwise or anticlockwise), whenever the LED device rotates more than a constant degree. The system displays the main menus after moving back the LED device to the starting position.

### 4 CONCLUSION

We proposed the information visualization technique using picture signs. This technique displays information that the user is hard to see. Using this technique, the user can grasp rough information about the objects by looking over them. Moreover, the user can compare information of objects easily by looking over the states of picture signs.

Our future work is that the user can add the information on objects for supporting works by multiple people. We will also discuss about other visualization techniques and how to adjust the parameters.

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### REFERENCES

- [1] Gerhard Schall, Erick Mendez, and Dieter Schmalstieg. Virtual redlining for civil engineering in real environments. In *ISMAR '08*, pp. 95–98, 2008.
- [2] Gunther Heidemann, Ingo Bax, and Holger Bekel. Multimodal interaction in an augmented reality scenario. In *ICMI'04*, pp. 53–60, 2004.
- [3] Antti Aaltonen and Juha Lehtikinen. Exploring augmented reality visualizations. In *AVI'06*, pp. 453–456, 2006.
- [4] Takashi Nakamura, Shin Takahashi, and Jiro Tanaka. One-finger interaction for ubiquitous environment. In *ICIS 2010*, pp. 267–272, 2010.