INFORMATION DETECTIVE: A WORKSTATION FOR EXPLORING THREE DIMENSIONAL INFORMATION SPACE

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ABSTRACT

Artificial reality is used to simulate two different kinds of space. One is the physical world. The other is a conceptual data model. A head mounted display can simulate the former. In this paper, we propose a system, *Information Detective*, to simulate the latter. Information Detective is a workstation for browsing complex information spaces. It consists of a small flat display and two tracking sensors. It behaves like a magnifying glass in three dimensional space and can show object details in a natural way. It is being developed to keep users from losing themselves in large and complex information spaces.

INTRODUCTION

Artificial reality has the potential of changing the standard personal workstation consisting of a display to show multiple windows, a keyboard and a mouse [3, 4]. A step in this direction is head mounted displays with position and orientation sensors, which have great power for simulating a virtual environment [1, 6]. They provide a method for observing and manipulating objects in a virtual world. But, there are many problems with using them in office environments. Head mounted displays are expensive. They require a large space for operation plus acceptance of the idea of wearing a strange apparatus on one's head.

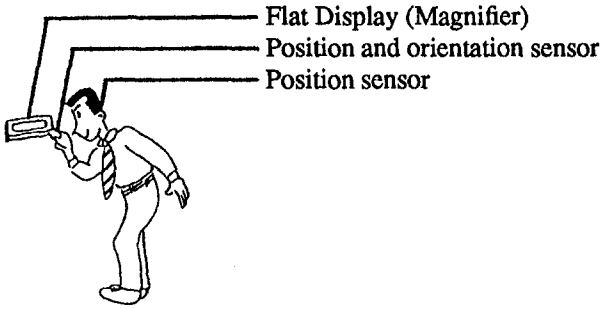
Artificial reality has two applications. One is to simulate the physical world; desk, wall, door, hand, etc. Head mounted display systems are well suited to these applications. The other is to simulate a conceptual data expression in a space, e.g., icons, menus, documents, etc. Today, the use of applications requiring complex information structures has increased. Hypertext is a typical example. Nodes and links in hypertext may be expressed in a three dimensional space. Such a system needs two capabilities; to navigate in a very large space and to look at the target objects in detail. The "Fisheye Lens" [2] provides these capabilities in the limited space of windows. It is effective if the context in the space is easy to understand. However, orientation in large and complex spaces becomes a serious problem for the user [5].

Artificial reality provides the power of navigation. Windows give us a method to look at items in detail. We combine both concepts in *Information Detective*.

SYSTEM OVERVIEW

Information Detective consists of a small flat display, a position and orientation sensor and a position sensor [Fig.1]. We call the flat display a *magnifier*. One of the sensors detects the absolute position and orientation of the magnifier. The other, which is set on the user's head, is used to calculate the distance and the view angle between the head and the magnifier. Using this data, the magnifier can show a synthetic view as if it is a magnifying glass in a virtual world.

Since a magnifying glass has a fixed focal distance, it has an area which is out of focus. Information Detective is designed to control this focusing. This is shown in the example scenario given below.



[Fig.1] INFORMATION DETECTIVE

1) Set the magnifier in front of eyes to see the whole scene.
   The user will see virtual documents on a desk or hung on strings in the room. The magnifier acts like a glass plate.
2) Walk toward the target object with the magnifier.
   The magnifier continues to act like a glass plate showing the target object growing larger.
3) Move the magnifier away from or toward the user.
   As the position of the magnifier is changed, the object enlarges or diminishes in size.
   The magnifier acts like a magnifying glass.

OPERATION OF THE MAGNIFIER

We believe that responses to the movements of the magnifier must be designed after modeling the information space. We think that the concept of focus is of great importance. An information space is very large and complex and a filtering function to hide detail is essential. In conceptual information space, seeing detail has two meanings. One is the original meaning; to see a small thing larger. The other is to see the detail expression of an object. Zooming in on an icon, for example, shows its contents, not an enlarged icon. We use *focus* in its metaphorical sense to express this second type of detail expression.

Information Detective provides two ways to reach an object in detail. One is to walk toward the object. The other is to adjust the magnifier. The information level given by the latter approach is equivalent to that of the physical approach.

COMPARISON WITH HEAD MOUNTED DISPLAYS

Here, we summarize the comparison of Information Detective (ID) with head mounted display systems.

1) ID extends the virtual distance that can be traversed.
2) ID will have a smaller footprint in the office.
3) ID allows users finer control over the resolution each display.
4) ID includes the same functions of head mounted non-stereoscopic displays without requiring the users to wear heavy headgear.

AVOIDING DISORIENTATION

The "Fisheye Lens" works only in the flat screen environment. In contrast, Information Detective gives the user a sense of moving in a real world, because his motion generate magnifications of the screen environment. Users will always see both a virtual world in the magnifier and the real physical world outside of the magnifier. They can also move easily between the detailed and world view of their space in order to navigate to new areas. This allows them to use the context of the entire information space to locate themselves.

CONCLUSION

Information detective provides a new way to navigate in information space such as a three dimensional hypertext representations.

We are trying to construct a datamodel for the information space. We are also planning to build a prototype as a next step.

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REFERENCES

[1] Fisher, S.S., McGreevy, M., Humphries, J. and Robinett, W. *Virtual Environment Display System.* ACM Workshop on Interactive 3D Graphics, Chapel Hill, NC., 1986, pp.77-87

[2] Furnas, G.W. *Generalized Fisheye Views.* CHI'86 Conference Proceedings, Boston, MA, pp16-23

[3] James D. Foley *Interfaces for Advanced Computing.* Scientific American, Oct 1987, pp.127-135

[4] Krueger, M. *Artificial Reality.* Addison-Wesley, 1983

[5] Mantei, M. *Disorientation Behavior in Person-Computer Interaction.* Ph.D. Dissertation, Univ. of Southern California, 1982

[6] Sutherland, I.E. *A Head-mounted Three Dimensional Display.* Fall Joint Computer Conference, 1968, pp.757-764