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DeLuca

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[54] **STEREOSCOPIC USER INTERFACE METHOD AND APPARATUS**

[76] Inventor: **Michael Joseph DeLuca**, 1104 Claire Ave., Austin, Tex. 78703

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[51] **Int. Cl.**[7] **G09G 5/00**

[52] **U.S. Cl.** **345/7**; 345/8; 345/419

[58] **Field of Search** 345/7, 8, 9, 419; 348/42, 47, 51

[56] **References Cited**

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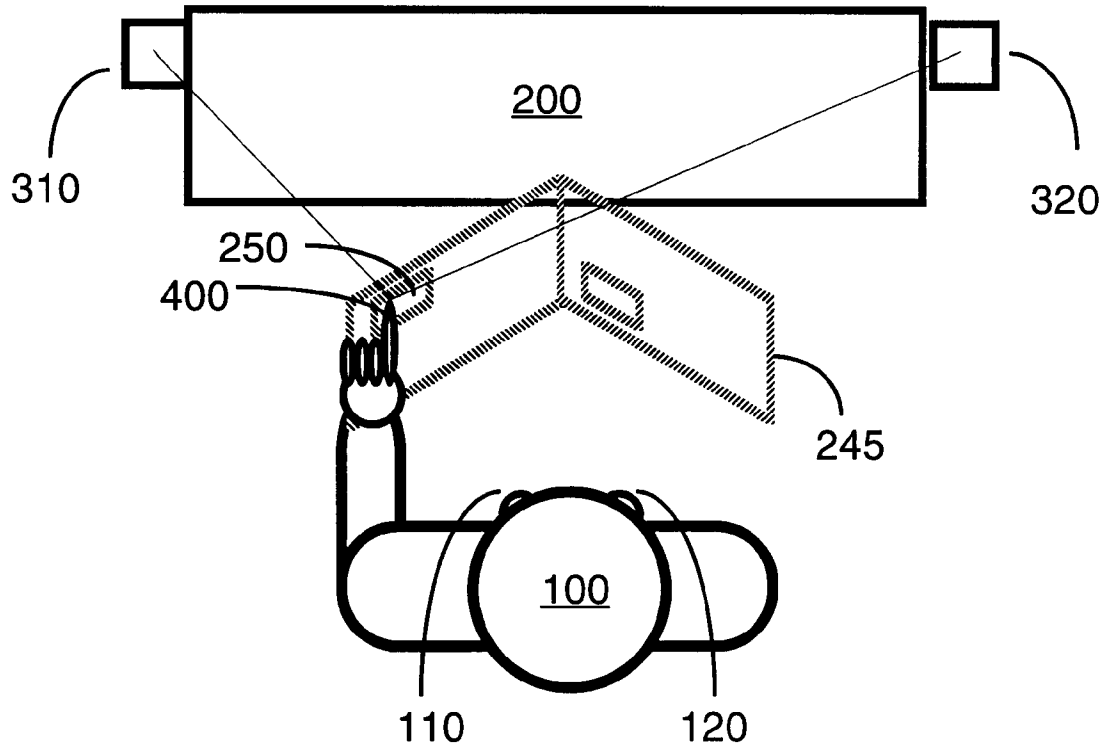
Primary Examiner—Richard A. Hjerpe
Assistant Examiner—Ronald Laneau

[57] **ABSTRACT**

A computer system stereoscopically projects a three dimensional object having an interface image in a space observable by a user. The user controls the movement of a physical object within the space while observing both the three dimensionally projected object and the physical object. The computer system monitors the position of the user to determine the position of the interface image within the space and further monitors the movement of the physical object to determine its position. A control signal is generated in response to the position of the physical object intersecting the position of the interface image. For example, a word processing program is indicated by an interface image such as an icon including the letter "W" three dimensionally projected within the space. The word processing program is activated when the user's finger moves within the space to touch the projected icon. The interface allows the user to observe the projected icon, physical finger and their intersection within the space. The physical object may also be extended with a stereoscopic extension image generated by the computer system in response to determining the position and orientation of the physical object.

20 Claims, 3 Drawing Sheets



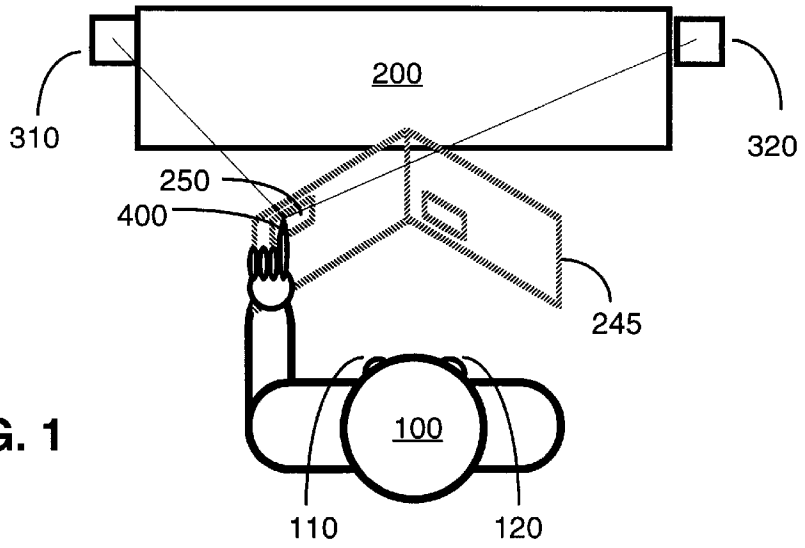


FIG. 1

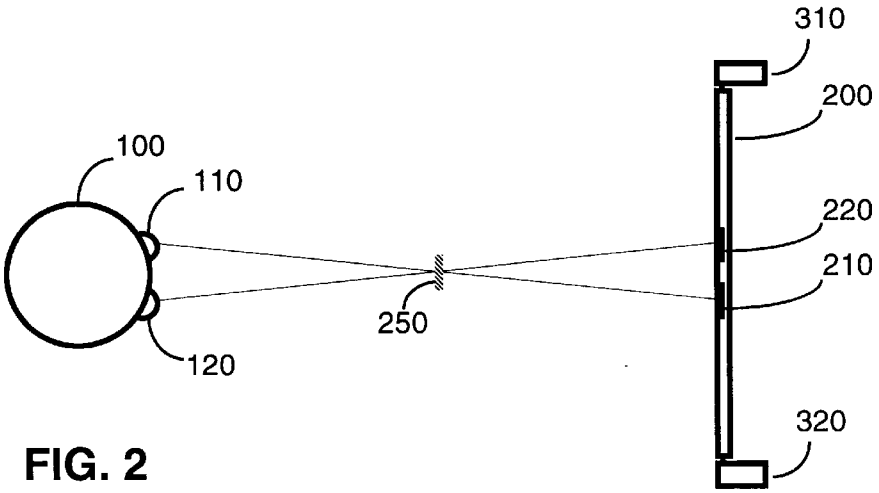


FIG. 2

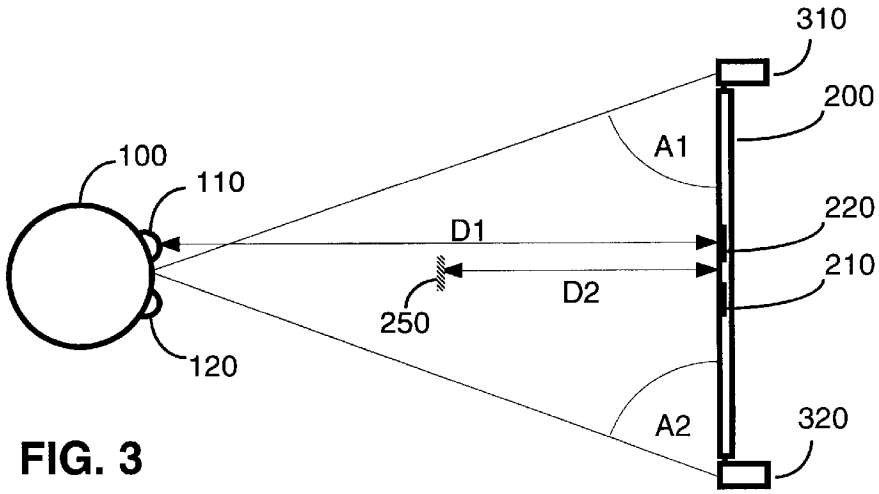


FIG. 3

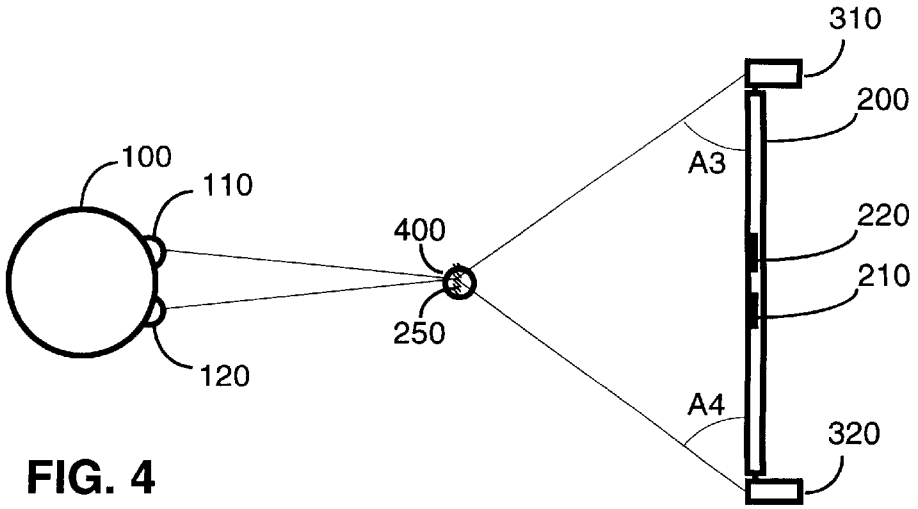


FIG. 4

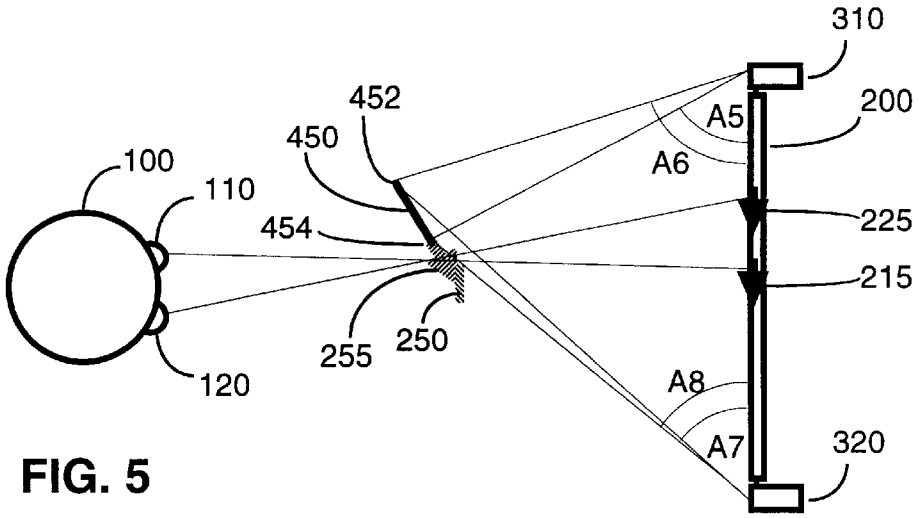


FIG. 5

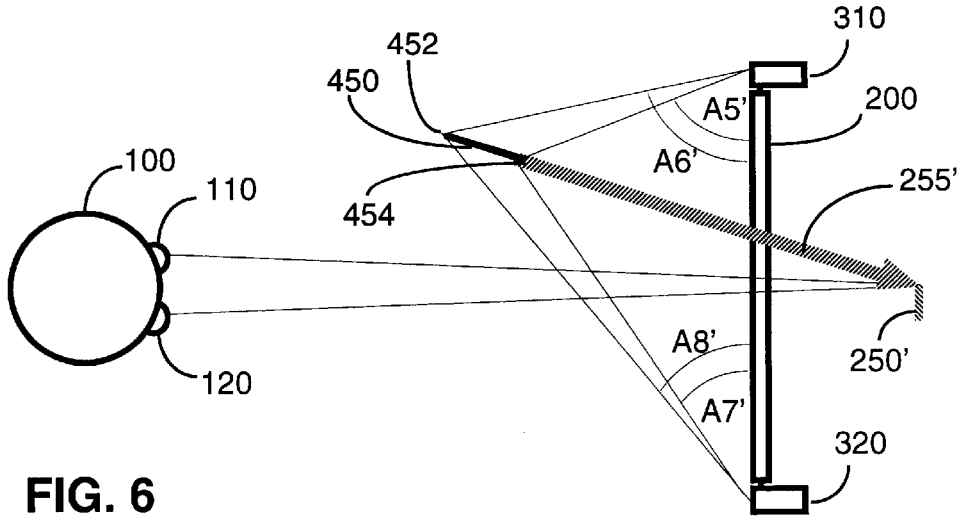


FIG. 6

FIG. 7

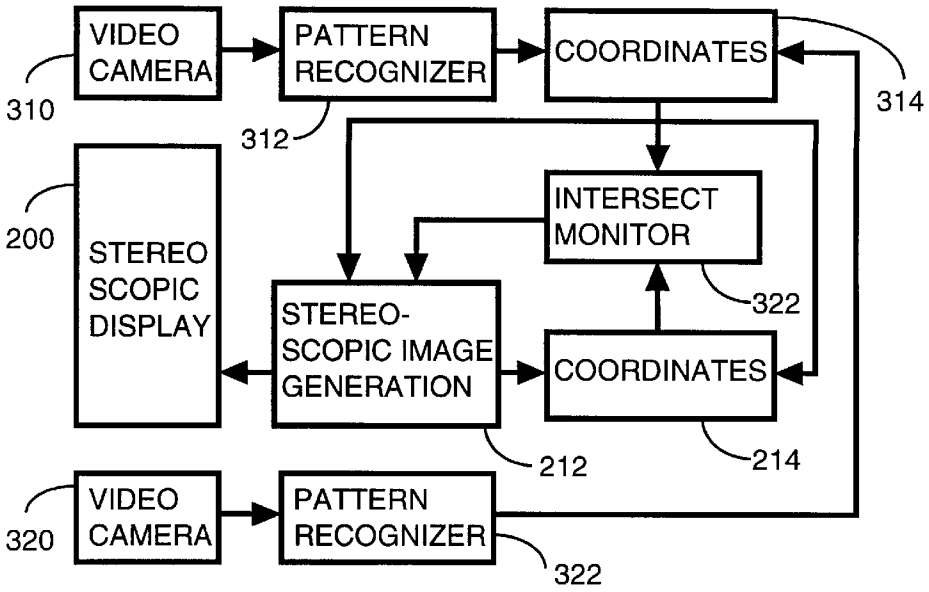
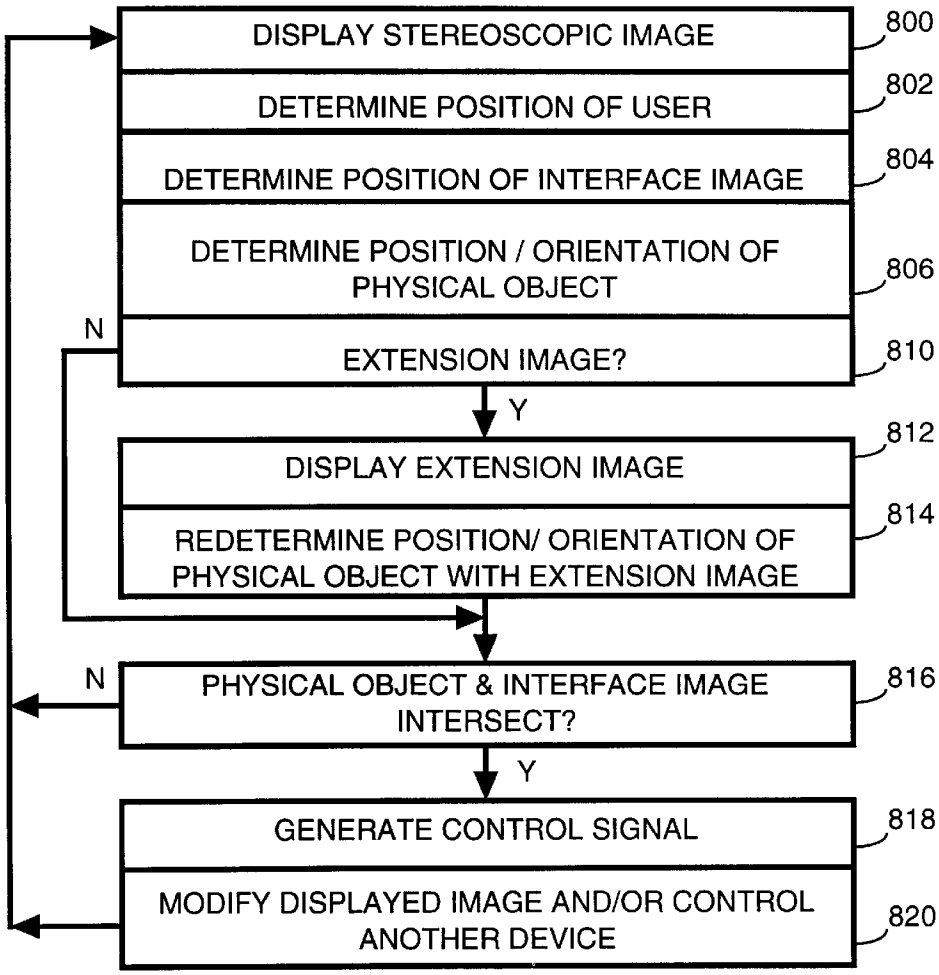


FIG. 8



STEREOSCOPIC USER INTERFACE METHOD AND APPARATUS

FIELD OF THE INVENTION

This invention generally relates to the area of computer user interfaces and more particularly to virtual three dimensional user interfaces.

BACKGROUND OF THE INVENTION

Graphical user interfaces have become a standard for interfacing between a user and a computer. Such interfaces are in wide use in computer operating system interfaces produced by Apple, Microsoft and others. These interfaces are limited in that they are intended for interfacing between a user and a computer having a two dimensional display such as a CRT or LCD. A user activates the interface with a key board and or a pointing device such as a mouse pointing to an icon on the display. Advancements have been made with the advent of a touch screen which allows a user to approximately contact the icon or intended area of the graphical user interface in order to use the interface. However, contact with the touch screen can contaminate the display area of the screen with finger prints and other types of smudges. Also, constant physical contact with the touch screen can result in its mechanical failure. Thus, what is needed is a way to contact user interface images without contacting a keyboard or a mouse or the display itself.

Three dimensional image displays are improving. Several types of three dimensional displays are known including stereoscopic displays which display a virtual three dimensional image using filters to highlight images intended for each eye of the viewer, thereby providing a stereoscopic or three dimensional affect. Such systems alternately flash images for the left and right eye of the user and require a filter for each eye, usually included in glasses worn by the viewer. Systems are in public use which require glasses may have color filters, orthogonally polarized lenses, or actively switched lenses, and the display is correspondingly modulated with left and right eye images to provide the three dimensional effect. Furthermore, stereoscopic displays which do not require glasses have been described, descriptions are included in U.S. Pat. No. 4,987,487, Jan. 22, 1991, to Ichinose et al. entitled Method of stereoscopic images display which compensates electronically for viewer head movement, and U.S. Pat. No. 5,365,370, Nov. 15, 1994, to Hudgins entitled Three dimensional viewing illusion with 2D display. Yet another stereoscopic display system in completely contained in a head set worn apparatus as described in U.S. Pat. No. 5,673,151 Sep. 30, 1997 to Dennis entitled Image correction in a virtual reality and heads up display. The aforesaid patents are incorporated by reference. The aforesaid stereoscopic displays allow the viewer to simultaneously observe both a stereoscopic object, appearing to be generally set apart in three dimensions from the image projection means, and a physical object, such as the hand of the user, in approximately the same perceived space. What is needed is a method and apparatus by which the intersection of the physical object and the stereoscopic object can form a user interface with a computer system.

OBJECT OF THE INVENTION

It is therefor an object of the invention to provide a three dimensional display system capable of determining an intersection of a physical object with a three dimensionally displayed object in a space where the three dimensional object is viewed and generating a control signal in response

thereto. The control signal may cause modification of the displayed image or control another device. The display system is also capable of extending the physical object with a three dimensional extension image and then using the extended image to determine the intersection.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** shows a perspective view of a user causing an intersection of a physical object with a three dimensional stereoscopic object projected by a display.

FIG. **2** shows the display of the stereoscopic interface image.

FIG. **3** shows determination of the position of the stereoscopic interface image.

FIG. **4** shows a physical object intersecting the stereoscopic interface image.

FIG. **5** shows a stereoscopic extension of the physical object intersecting the stereoscopic interface image.

FIG. **6** shows a stereoscopic extension image of the physical object intersecting the stereoscopic interface image wherein the intersection is behind the display.

FIG. **7** shows a block diagram of the user interface system operating in accordance with the present invention.

FIG. **8** shows a flow chart of a process operating in accordance with the present invention.

DETAILED DESCRIPTION OF THE INVENTION

FIG. **1** shows a perspective view of a user causing an intersection of a physical object with a three dimensional stereoscopic object projected by a display. The user **100** has left and right eyes **110** and **120** which are used to view a display **200** which projects a three dimensional stereoscopic object **245** in a space between the user and the display. The stereoscopic object has a stereoscopic interface image **250**. Using pattern recognition and triangulation, images from video cameras **310** and **320** are used to determine the position of physical objects within the space, such as the position of the user **100** and the user's finger **400**. As will be described herein, a control signal is generated in response to the intersection of the interface image **250** and a physical object **400**. For example, the stereoscopic object **245** projected by the display **200** could be the image of an open book, including readable text on pages of the book. Interface image **250** could be an icon indicating that contact with the icon would cause a page in the book to turn. When the finger tip **400** of the user touches the icon **250**, a control signal is generated causing a new image **245** of a book to be displayed with a turned page. The stereoscopic three dimensional image has the advantage of being projected in a space, no physical contact with a keyboard, mouse or touch screen is needed to generate a control signal to turn a page of the book. Rather, an intuitive action of a user appearing to make physical contact with a three dimensional image in the space causes generation of the control signal. The user sees the interface image in a three dimensional space and simply uses a finger to touch the interface image to cause a response. The user has an actual view of the finger, with which the user has had a life time to become familiar. touching a virtual stereoscopic object similar to the way the user has spent a life time touching physical objects. This provides for an intuitive interface.

The stereoscopic projector **200** can be any of several display means capable of displaying three dimensional images. Some projectors require the user to wear colored,

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