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User Interface Controls For Contoured Three-dimensional Virtual Displays

Anonymous

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ABSTRACT

Rendering user-interface controls on contoured virtual displays is computationally expensive. The usual solution is to render a whole second panel as an overlay and transform it to fit the contoured display. This disclosure describes computationally efficient techniques to render user interface controls for contoured three-dimensional virtual displays. Per the techniques, a user interface object is converted to a 3D-object defined by a collection of polygons and the polygons are attached to the contoured surface.

KEYWORDS

- Virtual display
- Contoured display
- Virtual reality
- User interface (UI) control
- Window panel
- Window chrome
- UI button

BACKGROUND

Virtual reality (VR) headsets enable the virtual display of user interfaces (e.g., that are traditionally displayed on a computer monitor) in a three dimensional virtual space. In some circumstances, the virtual display is not flat, e.g.,, planar. Rather, it is contoured, e.g., in the form of a cylinder or part thereof. Curved displays are considered superior for text legibility from any viewing angle, especially for larger displays.

However, rendering user-interface controls on contoured, virtual displays is computationally expensive. A common solution has been to render a whole second panel as an overlay, e.g., another flat layer, and transform it to fit the contoured display. Every additional layer adds to computational cost. Besides, for certain VR headsets, there may be hardware limits to the number of simultaneous layers that can be utilized.

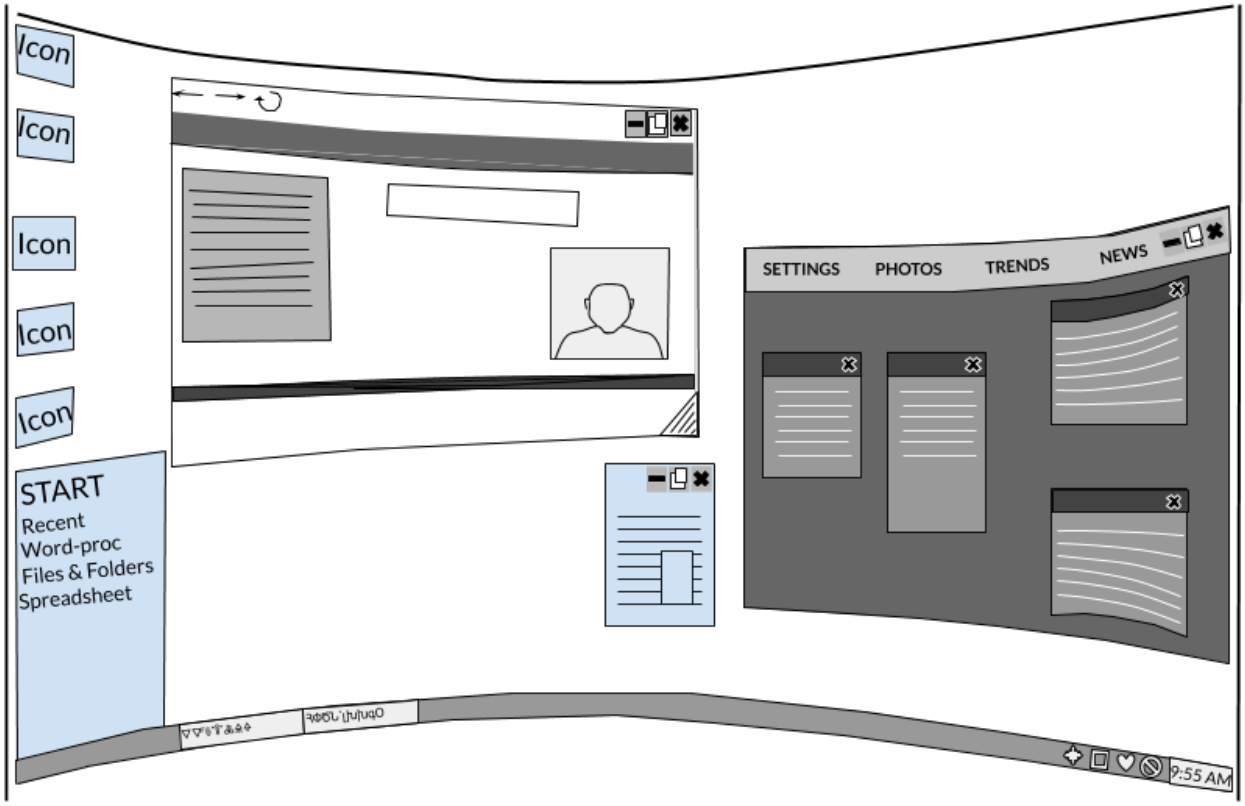

Fig. 1: A contoured virtual display

Fig. 1 illustrates a contoured virtual display, as seen, for example, using a VR headset.

DESCRIPTION

This disclosure describes efficient techniques to render user interface controls for contoured three-dimensional virtual displays. Per the techniques, a user-interface object is converted to a 3D-object defined by a collection of polygons and the polygons are attached to the

contoured surface. A two-dimensional user interface is directly displayed using polygons on a three-dimensional object, mapping the same surface as if it were displayed on a curved layer. Effectively, the user interface controls are displayed on the curves of the three-dimensional object such that they appear as a layer rather than as a 3D object.

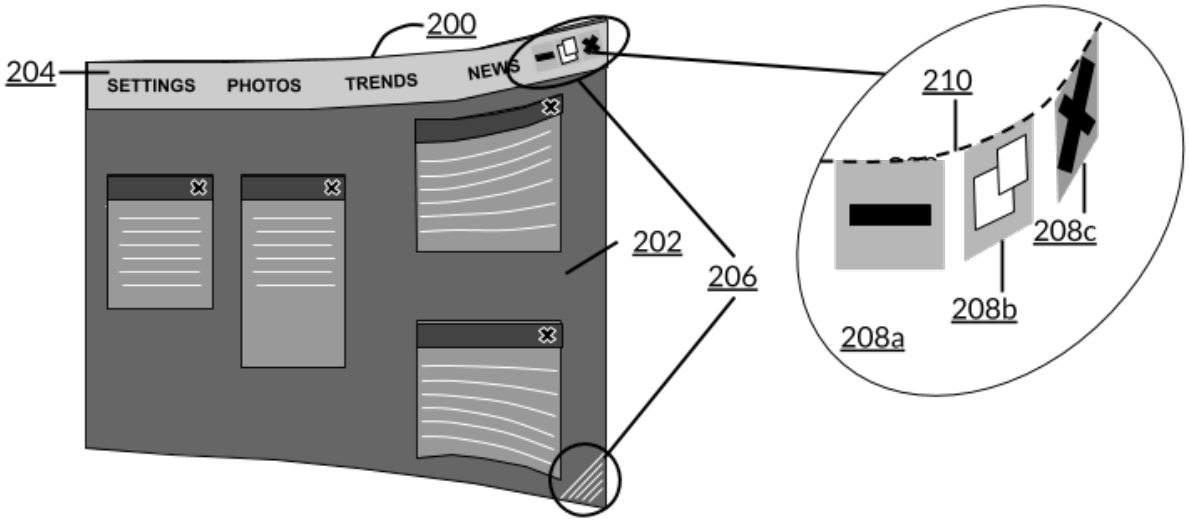

Fig. 2: Efficient rendering of user interface controls for contoured 3D virtual displays

Fig. 2 illustrates efficient rendering of user-interface controls for contoured 3D virtual displays, per the techniques of this disclosure. As seen in Fig. 2, an application window (200) includes a panel (202) and a chrome (204). The panel is the client area, controlled by the application. The chrome is the non-client window, drawn and managed by the operating system.

The chrome includes user interface controls (206) that enable a user to perform operations to modify the display of a window, e.g., to expand, contract, minimize, maximize, resize, move, etc. Per the techniques of this disclosure, the panel is drawn and rendered as a layer in the contoured 3D virtual display. The panel appears as a curved surface.

The components of the chrome, e.g., the UI control buttons (208a-c), shown in the exploded view, are directly rendered as simple, two-dimensional polygons in three-dimensional

space, e.g., two-dimensional objects that follow the three-dimensional curve of the application (210). The chrome is displayed on top of the panel without changing the content of the panel, and, to a user, appears completely integrated with the panel. The user sees a curved two-dimensional surface that is effectively indistinguishable from a three-dimensional surface.

In this manner, the computational expense of creating a new layer to display UI controls over an application is avoided. The techniques especially gain in memory and speed when multiple application instances run in parallel, a situation where UI controls can be established over the instances without adding layers. Additionally, the cost of resizing UI controls is also reduced.

CONCLUSION

This disclosure describes computationally efficient techniques to render user interface controls for contoured three-dimensional virtual displays. Per the techniques, a user interface object is converted to a 3D-object defined by a collection of polygons and the polygons are attached to the contoured surface.