METHOD FOR DISPLAYING STEREOSCOPIC IMAGE AND APPARATUS THEREOF

Start

Display content image

Receive command to provide UI/UX

Is first distance/second distance recognized?

No

Display by adjusting depth between plurality of objects constituting UI/UX in interaction with change in first distance/second distance

Yes

(Continued on next page)

Abstract: Provided is a display apparatus and method that may provide an optimized stereoscopic image screen by adjusting a depth between or a display angle of a plurality of objects in interaction with a change in a distance or a change in a location.
Description

Title of Invention: METHOD FOR DISPLAYING STEREOSCOPIC IMAGE AND APPARATUS THEREOF

Technical Field

The present invention relates to a method and apparatus for displaying a stereoscopic image, and more particularly, to a method and apparatus for displaying a stereoscopic image by controlling depths of a plurality of objects based on a distance from a user to a rear wall recognized in real time.

Background Art

Currently, with a high speed of information built up over an ultra-high speed information communication network, a digital terminal based multimedia service that provides a simply viewing and listening service is in gradual development into a hyperspace-type three-dimensional (3D) stereoscopic information communication service that enables a realistic and stereoscopic viewing, feeling, and enjoying beyond time and space.

In general, a stereoscopic image that expresses a 3D is based on a stereo vision principle using two eyes. The disparity between two eyes, that is, two eyes of a user are separate from each other by about 65 mm. Due to the disparity between two eyes, the left eye and the right eye view slightly different images. Such a difference of an image resulting from a difference between locations of the two eyes is referred to as a binocular disparity. A 3D stereoscopic image display apparatus enables the left eye to view only an image corresponding to the left eye and enables the right eye to view only an image corresponding to the right eye using the binocular disparity.

That is, the left eye and the right eye may view different two-dimensional (2D) images, respectively. When the two images are transferred to the brain through the retinas, the transferred images are fused at the brain and the perception of depth and reality of a 3D image may be reproduced.

A method of driving a stereoscopic image is classified into an autostereoscopic method and a stereoscopic method.

To express images of two channels on a single screen, a stereoscopic image display apparatus outputs channels one by one with alternately changing every other line in a horizontal or vertical direction.

The autostereoscopic method refers to a method of displaying a stereoscopic image by enabling a right-eye image to be transferred only to the right eye and enabling a left-eye image to be transferred only to the left eye when outputting the stereoscopic image.
Meanwhile, a method of wearing glasses refers to a method of displaying a stereoscopic image by disabling the left eye to view a right-eye image and disabling the right eye to view a left-eye image.

However, it may be difficult to display a uniform and stable stereoscopic image on a stereoscopic image display apparatus, regardless of a location of a user. In the case of a stereoscopic image display apparatus operating using an autostereoscopic method, technology for enabling a user to view a stereoscopic image regardless of a location of the user by tracking the location of the user and accordingly, shifting a liquid crystal static lens has been developed. However, the technology may expand an area in which the stereoscopic image is visible in the autostereoscopic method, however, may display only a 2 view image anywhere.

Further, with the development of electronic technology, various types of display apparatuses are in use in various fields. In particular, research about a next-generation display apparatus such as a transparent display apparatus is actively conducted.

The transparent display apparatus indicates a display apparatus that transmits a background present at the rear of the apparatus due to its transparent property. In the related art, a display panel has been manufactured using opaque semiconductor compounds such as silicone (Si) and gallium arsenic (GaAs). However, with the appearance of various application fields un-coverable by the exiting display panel, attempts to develop a new type of electronic device have been made. The transparent display apparatus is one of the developments accomplished under such efforts.

The transparent display apparatus includes a transparent oxide semiconductor film and has a transparent property. In the case of using the transparent display apparatus, a user may see through up to an object located at the rear of the display apparatus. Accordingly, the transparent display apparatus may outperform spatial and temporal constraints found in the existing display apparatuses.

The transparent display apparatus may be employed in various environments for various uses. For example, when a show window of a store is configured using the transparent display apparatus, a user may provide information by displaying, on the show window, related information about clothes worn by or a bag held by a mannequin located behind the show window. In addition, when a window of a house is configured using the transparent display apparatus, sense of field as if the user is located at a desired place may be provided by displaying, on the window, a background screen selected by the user.

As described above, due to the transparent property, the transparent display apparatus has many advantages compared to the existing display apparatus. On the contrary, due to the transparent property, an issue such as unclearly visible information on a screen may also arise.
Accordingly, there is a need for technology capable of further effectively and variously using the transparent display apparatus.

**Disclosure of Invention**

**Technical Problem**

The present invention is conceived to outperform the aforementioned issues and provides a stereoscopic image display method and apparatus that may provide a stereoscopic image screen with an optimized size regardless of a change in a distance from a user by adjusting depths of a plurality of objects based on a distance from the user to a rear wall and thereby displaying a stereoscopic image.

Also, the present invention provides a stereoscopic image display method and apparatus that may provide a stereoscopic image screen with optimized immersion regardless of a change in a location of a user by adjusting a display angle of a plurality of objects in interaction with a change in the location of the user and thereby displaying a stereoscopic image.

**Solution to Problem**

According to an embodiment of the present invention, there is provided a stereoscopic image display apparatus using a transparent flexible display, including an image receiver configured to receive a content image; a command receiver configured to receive a command to provide user interface (UI)/user experience (UX); a recognizer configured to recognize a distance from a user to a rear wall of the display apparatus or to recognize a direction in which the user is located, in response to the command to provide UI/UX received at the command receiver; a controller configured to control a plurality of objects constituting the UI/UX to be displayed by adjusting at least one of a depth between the plurality of objects and a display angle of the plurality of objects in interaction with at least one of a change in the recognized distance and a change in the recognized direction; and a display configured to provide a display screen according to a control of the controller.

The controller may increase or reduce sizes of the plurality of objects in interaction with at least one of the change in the recognized distance and the change in the recognized direction.

Also, the controller may increase or reduce sizes of the plurality of objects based on a user setting in a state in which the plurality of objects is displayed.

The recognizer may include a distance recognizer configured to recognize a first distance from the user located in front of the display apparatus and to recognize a second distance from the rear wall located at the rear of the display apparatus; and a direction recognizer configured to recognize the direction in which the user is located.

The plurality of objects may be an image separate from the content image being
displayed on the display apparatus and a UI/UX screen associated with various contents.

[23] The first distance may be a distance excluding a safe viewing distance for protecting eyesight of the user from a distance from the display apparatus to the user.

[24] Also, according to an embodiment of the present invention, there is provided a method of displaying a stereoscopic image at a stereoscopic image display apparatus using a transparent flexible display, the method including receiving a content image; receiving a command to provide UI/UX, and in response to the command, recognizing a distance from a user to a rear wall of the display apparatus or recognizing a direction in which the user is located; and controlling a plurality of objects constituting the UI/UX to be displayed by adjusting at least one of a depth between the plurality of objects and a display angle of the plurality of objects in interaction with at least one of a change in the recognized distance and a change in the recognized direction.

**Advantageous Effects of Invention**

[25] A stereoscopic image display method and apparatus according to embodiments of the present invention may provide a stereoscopic image screen with an optimized size regardless of a change in a distance from a user by adjusting depths of a plurality of objects based on a distance from the user to a rear wall and thereby displaying a stereoscopic image.

[26] Also, a stereoscopic image display method and apparatus according to embodiments of the present invention may provide a stereoscopic image screen with optimized immersion regardless of a change in a location of a user by adjusting a display angle of a plurality of objects in interaction with a change in the location of the user and thereby displaying a stereoscopic image.

**Brief Description of Drawings**

[27] FIG. 1 is a block diagram illustrating a configuration of a display apparatus for displaying a stereoscopic image according to an embodiment of the present invention.

[28] FIG. 2 is a flowchart illustrating a method of displaying a stereoscopic image in interaction with a change in a first distance and a second distance according to an embodiment of the present invention.

[29] FIG. 3 illustrates an example of a first distance and a second distance to be applied to a stereoscopic image display according to an embodiment of the present invention.

[30] FIG. 4 is a flowchart illustrating a method of displaying a stereoscopic image in interaction with a change in a location of a user according to an embodiment of the present invention.

[31] FIGS. 5A through 5C illustrate an example of a method of displaying an optimized stereoscopic image according to an embodiment of the present invention.
FIG. 6 illustrates an example of an operation method of a display apparatus in response to a gesture input according to an embodiment of the present invention.

**Best Mode for Carrying out the Invention**

Hereinafter, exemplary embodiments of the present invention will be described in detail with reference to the accompanying drawings. It should be noticed that if they are illustrated in different drawings, like reference numerals refer to like constituent elements throughout. Further, when it is determined detailed description related to a related known function or configuration they may make the purpose of the present invention unnecessarily ambiguous in describing the present invention, the detailed description will be omitted here.

Various embodiments of the present invention are described below. It should be understood that the inventions proposed herein may be embodied in various forms and predetermined structures or functions proposed herein, or all of them are provided as examples. Thus, those skilled in the art will understand that one embodiment proposed herein may be configured to be independent from other embodiments and two or more embodiments may be combined using a variety of methods. For example, a device/apparatus may be configured or a method may be implemented using a predetermined number of embodiments disclosed herein. Further, such a device/apparatus may be configured or such a method may be implemented using another structure or function, or another structure and function, in addition to one or more embodiments described herein or aside therefrom.

Hereinafter, the exemplary embodiments of the present invention will be described with reference to the accompanying drawings.

FIG. 1 is a block diagram illustrating a configuration of a display apparatus for displaying a stereoscopic image according to an embodiment of the present invention.

Referring to FIG. 1, a display apparatus according to an embodiment of the present invention may include an image receiver 110, a command receiver 120, a recognizer 130, a controller 140, and a display 150. The image receiver 110 may receive a content image transmitted from an outside. The image receiver 110 may receive image data transmitted from a broadcasting station and various contents downloaded through various types of online sites. Here, an image received through the image receiver 110 may include a two-dimensional (2D) image or a three-dimensional (3D) image. Meanwhile, an image to be displayed using the display apparatus may further include an image stored in a storage device included in the display apparatus and an image stored in a recording medium connected to the display apparatus, in addition to the image received at the image receiver 110.

The command receiver 120 may receive a command to provide user interface
(UI)/user experience (UX). In this case, when a function or a menu associated with UI/UX providing is selected by a user gesture or a user touch, the command receiver 120 may receive the command to provide UI/UX in response thereto. Here, the received command may include a command preset by a user.

The recognizer 130 may be sub-divided into a distance recognizer 131 and a direction recognizer 132. The distance recognizer 130 may recognize a first distance from the user and a second distance from a rear wall. That is, when the command to provide UI/UX is received at the command receiver 120, the distance recognizer 131 may recognize the first distance from the user located in front of the display apparatus and the second distance from the rear wall located at the rear of the display apparatus. Here, the first distance and the second distance may be used as values for controlling display depths of objects. That is, the display apparatus may provide a stereoscopic display screen by recognizing a distance from the user and a distance from the rear wall through the distance recognizer 131 and by applying depths the user may visually perceive together with a surrounding environment. Meanwhile, the direction recognizer 132 may recognize a direction in which the user is located in real time. Here, the direction recognizer 132 may recognize the direction in which the user is located as an angle based on the display apparatus.

The controller 140 may control a depth between a plurality of objects constituting the UI/UX in interaction with a change in the first distance and the second distance, and may control the plurality of objects to be displayed. Here, the controller 140 may increase or reduce sizes of the plurality of objects in interaction with the change in the first distance and the second distance. The controller 140 may change the sizes of the plurality of objects based on a user setting in a state in which the plurality of objects is displayed. The objects may refer to an independently configurable and playable image separate from the content image and may include a UI/UX screen associated with various contents capable of being provided from the display apparatus, such as a broadcast, a movie, a game, an advertisement, and a social network service (SNS). For example, the objects may include images associated with the respective contents, video, or electronic program guide (EPG) information.

The display 150 may provide a stereoscopic image screen to be displayed according to a control of the controller 140. The display 150 may be configured in a form of a transparent flexible display and may represent the cubic effect by displaying an image on a screen using a holographic method. For example, information to be displayed using the display 150 may include an image, a text, a content playback screen, an application execution screen, a web browser screen, and various graphic objects. The display 150 may be configured in a variety of forms such as a transparent liquid crystal display (LCD), a transparent organic light-emitting diode (OLED), and a transparent
thin film diode (TFD).

FIG. 2 is a flowchart illustrating a method of displaying a stereoscopic image in interaction with a change in a first distance and a second distance according to an embodiment of the present invention.

Referring to FIG. 2, a display apparatus according to an embodiment of the present invention may display a plurality of objects so that the cubic effect may be represented by recognizing a first distance from a user located in front of the display apparatus and a second distance from a rear wall located at the rear of the display apparatus, and by adjusting sizes of the plurality of objects included in an image or a display depth between the plurality of objects based on the recognized first distance and second distance. Initially, while displaying a content image in operation S210, the display apparatus may receive a command to provide UI/UX in operation S220. The content image may include image data transmitted from a broadcasting station and contents downloaded through various types of online sites. The command to provide UI/UX may include a command preset in the display apparatus and may also include a command input in real time.

When the first distance and the second distance are recognized in operation S230, the display apparatus may display the content image by adjusting the display depth between the plurality of objects constituting the UI/UX in interaction with a change in the first distance and the second distance in operation S240. The first distance and the second distance may be recognized by a distance recognizer configured in a predetermined module of a camera form provided to the display apparatus. For example, the distance recognizer in the predetermined module may be configured using a plurality of cameras and may be provided on a front surface/rear surface of the display apparatus. The display apparatus may stereoscopically display an image so that each of the plurality of objects may express a different perspective by applying a different depth to each of the plurality of objects constituting the UI/UX. That is, the display apparatus may readily adjust a level of the cubic effect of the image to be displayed by adjusting the depth between the plurality of objects. Here, the display apparatus may also recognize the second distance from the rear wall located at the rear of display apparatus together with the first distance from the user, and may adjust depths of the plurality of objects based on the recognized first distance and second distance. Also, in addition to the first distance and the second distance, the display apparatus may further set a third distance corresponding to a basic distance value for maintaining a safe viewing distance. The third distance may be modified to correspond to a screen size and thereby applied. Accordingly, the third distance may be differently applied according to an increase or a reduction in the size of the display screen.

FIG. 3 illustrates an example of a first distance and a second distance to be applied to
a stereoscopic image display according to an embodiment of the present invention.

Referring to FIG. 3, a display apparatus according to an embodiment of the present invention may modify the cubic effect using a method of recognizing a first distance from a user located in front of the display apparatus and a second distance from a rear wall located at the rear of the display apparatus and adjusting a depth between objects in interaction with a change in the first distance and the second distance.

In more detail, the display apparatus 310 may recognize distances for stereoscopic image display through a recognition module mounted to the display apparatus 310. The recognition module may be sub-divided into a distance recognizer configured to recognize a change in a distance required for adjusting the cubic effect of a stereoscopic image and a direction recognizer configured to recognize a change in a location of a user required for providing an optimized stereoscopic image. A distance recognized using the distance recognizer may include a first distance $D_1$ indicating a distance from a user located in front of the display apparatus 310 and a second distance $D_2$ indicating a distance from a rear wall 320 located at the rear of the display apparatus 310.

Here, a safe viewing distance to be applied when viewing a television (TV) using the display apparatus 310 may be separately applied as a third distance $D_3$. The third distance $D_3$ may be preset when setting a variety of functions for the stereoscopic image display. In this example, the display apparatus 310 may provide the user with an optimized stereoscopic image by applying the preset third distance $D_3$ in addition to the first distance $D_1$ and the second distance $D_2$ when displaying the stereoscopic image. That is, the third distance $D_3$, as the safe viewing distance to be applied for eyesight protection of the user, may be differently applied based on a size of the display apparatus 310. Accordingly, the first distance $D_1$ indicates a distance excluding the safe viewing distance, for example, the third distance $D_3$, for eyesight protection of the user from a distance from the display apparatus 310 to the user.

Also, the second distance $D_2$ may vary by adjusting a location of the display apparatus 310. The display apparatus 310 according to the present invention may move forward or backward with handing on the wall or from the ceiling, and may include a predetermined apparatus 330, for example, a small pulley such as an architecture of closely placing the display apparatus 310 on the wall or separating the display apparatus 310 from the wall, capable of adjusting a location of the display apparatus 310 at four corners of the display apparatus 310. Thus, the second distance $D_2$ from the display apparatus 330 to the rear wall 320 may also vary based on a location of the display apparatus 310 changed by the predetermined apparatus 330. Accordingly, it is possible to adjust the cubic effect of a display image by applying the second distance $D_2$.2
That is, by applying the first distance $D_1$ and the second distance $D_2$, recognized through the recognition module provided at a predetermined location, the display apparatus 310 may provide a screen of the display apparatus 310 on which a visual depth perceived by the user is applied together with a surrounding environment. In detail, the display apparatus 310 may represent the cubic effect based on perspective of objects by adjusting a depth or a distance between objects based on all of the first distance $D_1$ from the user viewing the screen and the second distance $D_2$ from the rear wall 320 located at the rear of the display apparatus 310 and thereby displaying the objects.

Meanwhile, the display apparatus 310 may adjust a display angle of objects based on a change in a location of the user recognized through the direction recognizer of the recognition module. That is, a 3D display screen provided from a general display apparatus may be displayed with being limited to a Z-axial value. However, the display apparatus 310 according to the present invention may recognize a change in a location of the user in real time, may apply a change in a Z-axial value occurring in response to the change in the location of the user, and may enable the user to experience perception of virtual space through an automatic interaction and an optical illusion.

As described above, a display apparatus according to the present invention may provide a stereoscopic image by further considering a second distance from a rear wall located at the rear of the display apparatus in addition to a first distance from a user and thus, may provide the user with an optimized image of which cubic effect is further emphasized.

FIG. 4 is a flowchart illustrating a method of displaying a stereoscopic image in interaction with a change in a location of a user according to an embodiment of the present invention.

Referring to FIG. 4, a display apparatus according to an embodiment of the present invention may provide a screen by recognizing a change in a location of a user and by adjusting a display angle of objects in real time based on the recognized change in the location of the user. Accordingly, regardless of a location at which the user uses the display apparatus, the user may view an optimized screen at all times.

In operation S410, the display apparatus may display a content image. The content image may include image data transmitted from a broadcasting station and contents downloaded through various types of sites.

When a change in a location of a user is recognized in operation S420, the display apparatus may control and display an angle of a plurality of objects constituting UI/UX in interaction with the change in the location of the user in operation S430. That is, the display apparatus may recognize an angle of a direction in which the user is located based on the display apparatus and an angle from the rear wall based on the display
apparatus using a recognition module provided in a predetermined area. The display apparatus may change and thereby display the angle of the plurality of objects so that the plurality of objects may be displayed in the direction in which the user is located, based on the recognized angles. For example, when the user is viewing an image in a right direction of the display apparatus, the display apparatus may recognize that the user is located in the right direction of the display apparatus using a predetermined direction recognition module provided in a predetermined area of the display apparatus, and may extract an angle from the location of the user and an angle from the rear wall based on the display apparatus. The display apparatus may display the plurality of objects by adjusting the display angle of the objects based on the extracted angle from the location of the user and angle from the rear wall.

As described above, according to embodiments of the present invention, regardless of a location to which a user is to move, the user may view a display screen at the front at all times and thus, may be provided with an optimized screen and may maximize an immersion.

FIGS. 5A through 5C illustrate an example of a method of displaying an optimized stereoscopic image according to an embodiment of the present invention.

FIG. 5A illustrates an example of a method of adjusting, by a display apparatus according to an embodiment of the present invention, the cubic effect by adjusting a depth between a plurality of objects.

Referring to FIG. 5A, the display apparatus according to an embodiment of the present invention may adjust the cubic effect of a display screen by adjusting the depth between the plurality of objects in interaction with a first distance \( D_1 \) and a second distance \( D_2 \).

The first distance \( D_1 \) indicates a distance from a user 520 located in front of the display apparatus 510, and the second distance indicates a distance from a rear wall 530 located at the rear of the display apparatus 510. The first distance \( D_1 \) and the second distance \( D_2 \) may be recognized through a predetermined recognition module provided to the display apparatus 510. A third distance \( D_3 \) to be separately applied, as a safe viewing distance recommend for eyesight protection of the user 520, may be preset by the user 520 and applied when providing a screen. The third distance \( D_3 \) may be differently applied based on a size of the display apparatus 510. Accordingly, the first distance \( D_1 \) indicates a distance excluding the safe viewing distance, for example, the third distance \( D_3 \), for the eyesight protection of the user 520 from a distance from the display apparatus 510 to the user 520.

The display apparatus 510 may provide the user 520 with a display screen on which the optimized cubic effect is represented by considering all of the recognized first distance \( D_1 \), second distance \( D_2 \), and third distance \( D_3 \). Here, the display screen to be
displayed through the display apparatus 510 may include a plurality of objects 511, 512, 513, and 514. The display apparatus 510 may adjust a depth \( D_1 \) between the plurality of objects 511, 512, 513, and 514 based on the recognized first distance \( D_1 \), second distance \( D_2 \), and third distance \( D_3 \).

Accordingly, although the depth \( D_1 \) between the plurality of objects 511, 512, 513, and 514 is constant, the user 520 may perceive as if a different depth is applied to each of the objects 511, 512, 513, and 514 at the location of the user 520. Accordingly, a screen may be stereoscopically recognized.

Referring to FIG. 5A, the display apparatus 510 may adjust depths of the objects 511, 512, 513, and 514 using all of an entire distance between the first distance \( D_1 \) and the second distance \( D_2 \). In detail, into consideration of a location separate from the user 520 by the third distance \( D_3 \), that is, the safe viewing distance, the first object 511 is located at a front line, for example, a boundary between \( D_1 \) and \( D_3 \), of a substantial user view allowed space, the fourth object 514 is located at the rear wall 530, and the second object 512 and the third object 513 are located at a predetermined depth between the first object 511 and the fourth object 514. Accordingly, the display apparatus 510 may stereoscopically display the plurality of objects 511, 512, 513, and 514 using a space from the front line of the substantial user view allowed space to the rear wall 530.

FIG. 5B illustrates an example of a method of adjusting, by a display apparatus according to an embodiment of the present invention, a display angle of an object based on a change in a location of a user according to an embodiment of the present invention.

Referring to FIG. 5B, the display apparatus 510 according to an embodiment of the present invention may display a screen by adjusting the display angle of the plurality of objects 511, 512, 513, and 514 by \( Q \) to face a direction in which the user 520 is recognized.

That is, when a location of the user 520 is changed, the display apparatus 510 may recognize the change in the location of the user 520 in real time and may adjust the display angle \( Q \) of the plurality of objects 511, 512, 513, and 514 so that the screen may face a user 520' even at the changed location of the user 520'. Here, the angle of the objects 511, 512, 513, and 514 may be acquired by measuring an angel from an original location of the user 520 to a changed location of the user 520' based on the display apparatus and by applying the measured angle to each of the objects 511, 512, 513, and 514. Accordingly, depths \( D_i \) of the objects 511, 512, 513, and 514 and a distance \( D_3 \) from the display apparatus 510 to the changed user location may vary in interaction therewith. Also, a third distance \( D_3 '\) that is a safe viewing distance provided
to the user may also vary based on the changed location of the first distance \( D'_1 \).

That is, the first object 511 may be located at a front line, that is, a boundary between \( D'_1 \) and \( D'_2 \), the fourth object 514 may be located at the rear wall 530, and the second object 512 and the third object 513 may be separate from each other by the pre-determined depth \( l_2 \) between the first object 511 and the fourth object 514. At the same time, the first through fourth objects 511, 512, 513, and 514 may move or rotate by the measured angle \( Q \).

Accordingly, since the user 520 may view the display screen at the front at all times regardless of a location of the user 520, the immersion of the user may be maximized by providing an optimized stereoscopic screen.

FIG. 5C illustrates an example of a method of adjusting, by a display apparatus according to an embodiment of the present invention, the cubic effect by adjusting an object size in interaction with a first distance and a second distance.

Referring to FIG. 5C, the display apparatus according to an embodiment of the present invention may adjust the cubic effect of a display screen by adjusting a size between the plurality of objects 511, 512, 513, and 514 in interaction with the first distance \( D_i \) and the second distance \( D_2 \). The display apparatus 510 may provide a screen so that the user 520 may perceive the optimized cubic effect at a location of the user 520 by resizing, for example, increasing or reducing sizes of the objects 511, 512, 513, and 514 constituting the display screen based on all of the first distance \( D_i \) indicating a distance from the user 520 located in front of the display apparatus 510 and the second distance \( D_2 \) indicating a distance from the rear wall 530 located at the rear of the display apparatus 510. In this case, the sizes of the objects 511, 512, 513, and 514 may gradually decrease according to an increase in distances from the user 520 to the plurality of objects 511, 512, 513, and 514. However, it is only an example and thus, the sizes of the objects 511, 512, 513, and 514 may gradually increase according to an increase in distances from the user 520 to the plurality of objects 511, 512, 513, and 514.

That is, the display apparatus 510 may stereoscopically display the plurality of objects 511, 512, 513, and 514 using a space from the front line, that is, the boundary between \( D_1 \) and \( D_3 \), of the substantial user view allowed space to the rear wall 530 and in this instance, may display the plurality of objects 511, 512, 513, and 514 with different sizes.

FIG. 6 illustrates an example of an operation method of a display apparatus in response to a gesture input according to an embodiment of the present invention.

A user may view a screen provided through a transparent display apparatus 611 as indicated with dotted lines [S610]. The display screen may include a plurality of objects 612, 613, 614, 615, 616, 617, and 618. The plurality of objects 612, 613, 614,
615, 616, 617, and 618 may be displayed as a UI/UX screen associated with various contents in response to a command to provide UI/UX. In this example, the plurality of objects 612, 613, 614, 615, 616, 617, and 618 may be stereoscopically displayed on a space from the user to a rear wall of the display apparatus 611 with being separated by predetermined depths.

Here, the display apparatus 611 may receive a selection signal for selecting a predetermined object, for example, the object 612 from among the plurality of objects 612, 613, and 614 being displayed through the display apparatus 612, by a user input, for example, a gesture input [S620], or may receive a control signal for moving locations of the objects 612, 613, and 614 [S630].

When an image related object, for example, the object 613 is selected by the user input [S640], the display apparatus 611 may play an image associated with the selected image related object on a screen of the display apparatus 611 [S650].

Although a few embodiments of the present invention have been shown and described, they are provided only to help the overall understanding of the invention and the present invention is not limited to the described embodiments. Instead, it would be appreciated by those skilled in the art that various changes and modifications may be made from the description without departing from the principles and spirit of the invention.

Therefore, the scope of the invention is defined not by the detailed description, but by the claims and their equivalents, and all variations within the scope of the claims and their equivalents are to be construed as being included in the invention.
Claims

[Claim 1] A stereoscopic image display apparatus using a transparent flexible display, comprising:
an image receiver configured to receive a content image;
a command receiver configured to receive a command to provide user interface (UI)/user experience (UX);
a recognizer configured to recognize a distance from a user to a rear wall of the display apparatus or to recognize a direction in which the user is located, in response to the command to provide UI/UX received at the command receiver;
a controller configured to control a plurality of objects constituting the UI/UX to be displayed by adjusting at least one of a depth between the plurality of objects and a display angle of the plurality of objects in interaction with at least one of a change in the recognized distance and a change in the recognized direction; and
a display configured to provide a display screen according to a control of the controller.

[Claim 2] The stereoscopic image display apparatus of claim 1, wherein the controller is configured to increase or reduce sizes of the plurality of objects in interaction with at least one of the change in the recognized distance and the change in the recognized direction.

[Claim 3] The stereoscopic image display apparatus of claim 1, wherein the controller is configured to increase or reduce sizes of the plurality of objects based on a user setting in a state in which the plurality of objects is displayed.

[Claim 4] The stereoscopic image display apparatus of claim 1, wherein the recognizer comprises:
a distance recognizer configured to recognize a first distance from the user located in front of the display apparatus and to recognize a second distance from the rear wall located at the rear of the display apparatus; and
a direction recognizer configured to recognize the direction in which the user is located.

[Claim 5] The stereoscopic image display apparatus of claim 1, wherein the plurality of objects is an image separate from the content image being displayed on the display apparatus and a UI/UX screen associated with various contents.
[Claim 6] The stereoscopic image display apparatus of claim 4, wherein the first distance is a distance excluding a safe viewing distance for protecting eyesight of the user from a distance from the display apparatus to the user.

[Claim 7] A method of displaying a stereoscopic image at a stereoscopic image display apparatus using a transparent flexible display, the method comprising receiving a content image; receiving a command to provide user interface (UI)/user experience (UX), and in response to the command, recognizing a distance from a user to a rear wall of the display apparatus or recognizing a direction in which the user is located; and controlling a plurality of objects constituting the UI/UX to be displayed by adjusting at least one of a depth between the plurality of objects and a display angle of the plurality of objects in interaction with at least one of a change in the recognized distance and a change in the recognized direction.

[Claim 8] A non-transitory computer-readable medium storing a program to implement the method of claim 7.

[Claim 9] A computer program stored in a non-transitory computer-readable medium to implement the method of claim 7.
[Fig. 1]

Image receiver → 110 → Controller → 140 → Display
Command receiver → 120 → Controller

Distance recognizer 130 → 131 → Direction recognizer 132

[Fig. 2]

Start → S210 → Display content image

Receive command to provide UI/UX → S220

Is first distance/second distance recognized? → S230

No →

Yes → Display by adjusting depth between plurality of objects constituting UI/UX in interaction with change in first distance/second distance → S240 → End
Start

Display content image

Is change in location of user recognized?

No

Yes

Display by adjusting depth between plurality of objects constituting UI/UX in interaction with change in first distance/second distance

End
**INTERNATIONAL SEARCH REPORT**

**A. CLASSIFICATION OF SUBJECT MATTER**

H04N 13/04(2006.01)i, H04N 13/00(2006.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

**B. FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)
H04N 13/04; G06T 15/20; G06T 15/00; G06K 9/00; G06F 3/041; H04N 13/00

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

- Korean utility models and applications for utility models
- Japanese utility models and applications for utility models

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
eKOMPASS(KIPO internal) & Keywords: stereoscopic image, distance, direction, recognize, command

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

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<tr>
<th>Category</th>
<th>Citation of document, with indication, where appropriate, of the relevant passages</th>
<th>Relevant to claim No.</th>
</tr>
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<tr>
<td>Y</td>
<td>US 2012-0262448 Al (JONGHwan Kim et al.) 18 October 2012 See paragraphs [0055] - [0063], [0102H0146], [0187]; and figures 1-3A, 5.</td>
<td>1-9</td>
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<td>Y</td>
<td>US 2014-0063207 Al (SUPERD Co., Ltd.) 06 March 2014 See paragraphs [0024], [0051H0073]; and figures 1-2, 7-8.</td>
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<td>Y</td>
<td>US 2013-0088488 Al (YE HONG) 11 April 1 2013 See paragraphs [0051H0058], [0064]-[0069]; claim 1; and figures 4, 6.</td>
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<td>Y</td>
<td>US 2013-0050196 Al (KAZUHIRO TAKASHIMA et al.) 28 February 2013 See paragraphs [0013H0018], [0030]-[0035]; claim 1; and figures 1-3.</td>
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<td>A</td>
<td>KR 10-2012-0014411 A (LG ELECTRONICS INC.) 17 February 2012 See paragraphs [0015H0018], [0042]-[0048]; claim 1; and figures 1-4.</td>
<td>1-9, 1-5, 7-9</td>
</tr>
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Further documents are listed in the continuation of Box C.

- * Special categories of cited documents:
  - "A" document defining the general state of the art which is not considered to be of particular relevance
  - "E" earlier application or patent but published on or after the international filing date
  - "L" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
  - "O" document referred to by the cited documents but not considered to be of relevance to the claim as a whole

See patent family annex.

**Date of the actual completion of the international search**

21 September 2015 (21.09.2015)

**Date of mailing of the international search report**

22 September 2015 (22.09.2015)

**Name and mailing address of the ISA/KR**

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Form PCT/ISA/210 (second sheet) (January 2015)
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Form PCT/ISA/2 10 (patent family annex) (January 2015)