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United States Patent	12393049
Kind Code	B2
Date of Patent	August 19, 2025
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Adaptive interactive campfire display

Abstract

A system for generating a floating three-dimensional image display within a vehicle includes an image chamber including a first display adapted to project a first image, a first reflector associated with the first display and a first passenger, a second display adapted to project a second image, and a second reflector associated with the second display and a second passenger, and a transparent display positioned between the first reflector and the first passenger, and between the second reflector and the second passenger, the first reflector adapted to reflect the first image from the first display to the first passenger, and the second reflector adapted to reflect the second image from the second display to the second passenger, and the transparent display adapted to display information to the first and second passengers within an image plane positioned in front of the perceived first and second images.

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Appl. No.: **18/153767**

Filed: **January 12, 2023**

Prior Publication Data

Document Identifier	Publication Date
US 20240241389 A1	Jul. 18, 2024

Publication Classification

Int. Cl.: **G02B30/56** (20200101); **B60R11/02** (20060101); **B60R11/04** (20060101); **G02B27/00** (20060101); **G02B30/31** (20200101); **G06F3/01** (20060101); B60R11/00 (20060101); G02B27/14 (20060101); G06F3/041 (20060101)

U.S. Cl.:

CPC **G02B30/31** (20200101); **B60R11/0229** (20130101); **B60R11/04** (20130101); **G02B27/0093** (20130101); **G06F3/012** (20130101); **G06F3/013** (20130101); **G06F3/017** (20130101); B60R2011/0028 (20130101); B60R2011/0029 (20130101); B60R2011/0282 (20130101); G02B27/14 (20130101); G06F3/041 (20130101)

Field of Classification Search

CPC: G03B (21/26); G03B (21/62); G02B (30/56)

USPC: 359/443

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Background/Summary

INTRODUCTION

(1) The present disclosure relates to a system for generating a floating image viewable by a plurality of passengers within a vehicle.

(2) Current entertainment systems within vehicles generally comprise a screen or monitor that is mounted within the vehicle for viewing by the passengers. Some systems include smaller individual screens, wherein each passenger has a screen for their personal viewing. Current systems that provide virtual holographic images do not include the ability for annotation and for information that cannot be embedded within the virtual holographic image to be presented with the virtual holographic image. In addition, current systems do not include tactile properties that allow a passenger to interact with the virtual holographic image, such as by making selections or choosing different images to view. Known systems incorporate inverse head-up-display architectures that use beams splitters that must be attached to structure within the vehicle compartment and must be constantly re-adjusted to accommodate height and position variations of the passengers within the vehicle compartment.

(3) While current systems achieve their intended purpose, there is a need for a new and improved system for providing a floating three-dimensional image that appears centrally located within the vehicle to all the passengers within the vehicle.

SUMMARY

(4) According to several aspects of the present disclosure, a system for generating a centrally located floating three-dimensional image display for a plurality of passengers positioned within a vehicle includes an image chamber including a first display adapted to project a first image, a first reflector individually associated with the first display and a first one of the plurality of passengers, a second display adapted to project a second image, and a second reflector individually associated with the second display and a second one of the plurality of passengers, and a transparent display positioned between the first reflector and the first passenger, and between the second reflector and the second passenger, the first reflector adapted to receive the first image from the first display and to reflect the first image to the first passenger, wherein the first passenger perceives the first image floating at a central location within the image chamber, and the second reflector adapted to receive the second image from the second display and to reflect the second image to the second passenger, wherein, the second passenger perceives the second image floating at the central location within the image chamber, and the transparent display adapted to display information to the first and second passengers within an image plane positioned in front of the perceived first and second images floating at the central location within the image chamber.

(5) According to another aspect, the image chamber further includes a first transparent portion adapted to allow the first image reflected by the first reflector to pass from the image chamber outward toward the first passenger, a second transparent portion adapted to allow the second image reflected by the second reflector to pass from the image chamber outward toward the second passenger, and solid portions adapted to prevent light from entering the image chamber behind the first and second reflectors.

(6) According to another aspect, the transparent display is a transparent touch screen positioned between eyes of the first passenger and the first image floating at the central location within the image chamber, between eyes of the second passenger and the second image floating at the central location within the image chamber, and adapted to allow the first and second passengers to provide input to the system.

(7) According to another aspect, the transparent display includes a transparent cylindrical touch screen.

(8) According to another aspect, the system is selectively moveable vertically up and down along a vertical central axis, the first display and the first reflector are unitarily and selectively rotatable about the vertical central axis, and the second display and the second reflector are unitarily and selectively rotatable about the vertical central axis.
(9) According to another aspect, the system further includes first sensors adapted to monitor a position of a head and eyes of the first passenger, wherein, the first display and first reflector are adapted to rotate in response to movement of the head and eyes of the first passenger, and second sensors adapted to monitor a position of a head and eyes of the second passenger, wherein, the second display and the second reflector are adapted to rotate in response to movement of the head and eyes of the second passenger, the system adapted to move up and down along the vertical axis in response to movement of the head and eyes of the first passenger and movement of the head and eyes of the second passenger.
(10) According to another aspect, the transparent display is an organic light-emitting diode.
(11) According to another aspect, the system further includes a first gesture sensor adapted to gather information related to gestures made by the first passenger, and a second gesture sensor adapted to gather information related to gestures made by the second passenger, wherein, the system is adapted to receive input from the first and second passengers via data collected by the first and second gesture sensors.
(12) According to another aspect, the system is mounted to and supported by one of a roof within the vehicle and a floor within the vehicle.
(13) Further areas of applicability will become apparent from the description provided herein. It should be understood that the description and specific examples are intended for purposes of illustration only and are not intended to limit the scope of the present disclosure.

Description

BRIEF DESCRIPTION OF THE DRAWINGS
(1) The drawings described herein are for illustration purposes only and are not intended to limit the scope of the present disclosure in any way.
(2) FIG. **1** is a schematic side view of a system in accordance with an exemplary embodiment of the present disclosure;
(3) FIG. **2** is a schematic top view of a vehicle compartment having a system in accordance with an exemplary embodiment of the present disclosure;
(4) FIG. **3** is a schematic top view of the system shown in FIG. **1** with a first and second passenger;
(5) FIG. **4** is a schematic perspective view of the system shown in FIG. **1**;
(6) FIG. **5** is a schematic top view of the system shown in FIG. **3**, wherein the position of the second passenger has moved;
(7) FIG. **6** is a schematic view of a monitoring system and first, second and third motors for moving the system;
(8) FIG. **7** is a schematic view illustrating a passenger viewing an image and annotation information through an associated beam splitter and passenger interface; and
(9) FIG. **8** is a top schematic view of a system in accordance with the present disclosure adapted for use by a single passenger.
(10) The figures are not necessarily to scale, and some features may be exaggerated or minimized, such as to show details of particular components. In some instances, well-known components, systems, materials or methods have not been described in detail in order to avoid obscuring the present disclosure. Therefore, specific structural and functional details disclosed herein are not to be interpreted as limiting, but merely as a basis for the claims and as a representative basis for teaching one skilled in the art to variously employ the present disclosure.

DETAILED DESCRIPTION

(11) The following description is merely exemplary in nature and is not intended to limit the present disclosure, application, or uses. Furthermore, there is no intention to be bound by any expressed or implied theory presented in the preceding technical field, background, brief summary or the following detailed description. It should be understood that throughout the drawings, corresponding reference numerals indicate like or corresponding parts and features. As used herein, the term module refers to any hardware, software, firmware, electronic control component, processing logic, and/or processor device, individually or in any combination, including without limitation: application specific integrated circuit (ASIC), an electronic circuit, a processor (shared, dedicated, or group) and memory that executes one or more software or firmware programs, a combinational logic circuit, and/or other suitable components that provide the described functionality. Although the figures shown herein depict an example with certain arrangements of elements, additional intervening elements, devices, features, or components may be present in actual embodiments. It should also be understood that the figures are merely illustrative and may not be drawn to scale.

(12) As used herein, the term “vehicle” is not limited to automobiles. While the present technology is described primarily herein in connection with automobiles, the technology is not limited to automobiles. The concepts can be used in a wide variety of applications, such as in connection with aircraft, marine craft, other vehicles, and consumer electronic components.

(13) Referring to FIG. **1** and FIG. **2**, a system **10** for generating a centrally located floating three-dimensional image **12** display for a plurality of passengers **14** positioned within a vehicle, includes an image chamber **16** that includes a first display **18** that is adapted to project a first three-dimensional image **12**A and a first reflector **20** individually associated with the first display **18** and a first one **14**A of the plurality of passengers **14**, and a second display **22** that is adapted to project a second three-dimensional image **12**B and a second reflector **24** individually associated with the second display **22** and a second one **14**B of the plurality of passengers **14**. As shown in FIG. **1**, the system **10** includes two displays **18**, **22**, reflectors **20**, **24** and passengers **14**A, **14**B. It should be understood that the system **10** may be adapted to accommodate any suitable number of passengers **14**.

(14) Referring to FIG. **2**, a vehicle compartment **26** includes a plurality of seating positions occupied by a plurality of passengers **14**A, **14**B, **14**C, **14**D. As shown, the vehicle compartment **26** includes four seating positions for four passengers **14**A, **14**B, **14**C, **14**D. Each reflector **20**, **24**, **28**, **30** is adapted to be viewed by one of the passengers **14**A, **14**B, **14**C, **14**D. Each reflector **20**, **24**, **28**, **30** is adapted to receive an image from the associated display **18**, **22**, and to reflect the image to the associated passenger **14**. The associated passenger **14** perceives the image **12** floating at a central location within the image chamber **16**. Referring again to FIG. **1**, the first reflector **20** is adapted to receive the first image **12**A from the first display **18**, as indicated by arrows **32**, and to reflect the first image **12**A to the first passenger **14**A, as indicated by arrows **34**, wherein the first passenger **14**A perceives the first image **12**A floating at a central location within the image chamber **16**, as indicated by arrows **36**. The second reflector **24** is adapted to receive the second image **12**B from the second display **22**, as indicated by arrows **38**, and to reflect the second image **12**B to the second passenger **14**B, as indicated by arrows **40**, wherein, the second passenger **14**B perceives the second image **12**B floating at the central location within the image chamber **16**, as indicated by arrows **42**.

(15) Referring to FIG. **2**, each of the four passengers **14**A, **14**B, **14**C, **14**D perceives an image **12** reflected to them by respective associated reflectors **20**, **24**, **28**, **30** and the passengers **14**A, **14**B, **14**C, **14**D perceive the image **12** reflected to them within the image chamber **16**, as indicated by lines **44**. Each of the displays **18**, **22** can project the same image to each of the reflectors **20**, **24**, **28**, **30** and thus to each of the passengers **14**A, **14**B, **14**C, **14**D. Alternatively, each of the displays **18**, **22** can display a different perspective of the same image, or a different image altogether to each of the reflectors **20**, **24**, **28**, **30**. Thus the system **10** is capable of presenting the same floating image

12 to all the passengers **14** so they can view simultaneously, or alternatively, each passenger **14** can view a different perspective of the floating image **12** or a completely different three-dimensional image **12**.

(16) A transparent display **46** is positioned between the eyes of each of the plurality of passengers **14** and the reflectors **20**, **24**, **28**, **30**. As shown in FIG. **1**, the transparent display **46** is positioned between the first reflector **20** and the first passenger **14**A and between the second reflector **24** and the second passenger **14**B. The transparent display **46** is adapted to display information to the first and second passengers **14**A, **14**B within an image plane positioned in front of the perceived first and second images **12**A, **12**B floating at the central location within the image chamber **16**. The transparent display **46** presents information to the first passenger **14**A that appears within a first image plane **48**, wherein information displayed on the transparent display **46** to the first passenger **14**A appears in front of the image **12**A perceived by the first passenger **14**A within the image chamber **16**. The transparent display **46** presents information to the second passenger **14**B that appears within a second image plane **50**, wherein information displayed on the transparent display **46** to the second passenger **14**B appears in front of the image **12**B perceived by the second passenger **14**B within the image chamber **16**.

(17) In an exemplary embodiment, the transparent display **46** is a transparent touch screen that is adapted to allow the plurality of passengers **14** to receive annotated information and to provide input to the system **10**. Referring to FIG. **1** and FIG. **2**, in an exemplary embodiment, the transparent display **46** includes a clear cylindrical touch screen. The clear cylindrical touch screen encircles the image chamber **16** and is thereby positioned between the eyes of the plurality of passengers **14** and the perceived image **12** floating at the central location within the image chamber **16**. In an exemplary embodiment, the transparent display **46** is an organic light-emitting diode (OLED). It should be understood, that the transparent display **46** may be other types of transparent touch screen displays known in the art.

(18) The transparent display **46** is adapted to present visible displayed information only to the passenger **14** that is directly in front of a portion of the transparent display **46**. The nature of the transparent display **46** is such that the displayed information is only displayed on a first side, the outward facing cylindrical surface, of the transparent display **46**. A second side, the inward facing cylindrical surface, of the transparent display **46** does not display information, and thus, when viewed by the other passengers **14**, allows the other passengers **14** to see through the transparent display **46**.

(19) In an exemplary embodiment, the images from each of the displays **18**, **22** are generated via holographic method, pre-computed and encoded into a hologram generator within the display **18**, **22**. In an exemplary embodiment, each display **18**, **22** is adapted to project a three-dimensional image with variable virtual image distance. Three-dimensional images with variable virtual image distance allows the system **10** to project a floating image **12** to the passengers **14** with the capability of making the floating image **12** appear closer or further away from the passengers **14**.

(20) Referring again to FIG. **1**, in an exemplary embodiment, the system is mounted to a support structure suspended from a roof **28** within the vehicle compartment **20**. Alternatively, in another exemplary embodiment, the system is mounted to a support structure, such as a pedestal, mounted to a floor **30** within the vehicle compartment **20**. In various embodiments, the system bay be retractable, wherein, when not in use, the system recesses within the roof or the floor within the vehicle compartment.

(21) The transparent display **46** and each of the reflectors **20**, **24**, **28**, **30** are transparent, wherein a passenger **14** can see through the transparent display **46** and an associated reflector **20**, **24**, **28**, **30**. This allows the passenger **14** to perceive the floating image **12** at a distance beyond the reflector **20**, **24**, **28**, **30** and further, allows the passenger **14** to see through the transparent display **46** and the reflectors **20**, **24**, **28**, **30** and able to see the interior of the vehicle compartment **26** and other passengers **14** therein.

(22) In one exemplary embodiment, the transparent display **46** is an autostereoscopic display that is adapted to display stereoscopic, or three-dimensional images by adding binocular perception of three-dimensional depth without the use of special headgear, glasses, something that affects the viewer's vision, or anything for the viewer's eyes. Because headgear is not required, autostereoscopic displays are also referred to as “glasses-free 3D” or “glassesless 3D”. The autostereoscopic transparent display includes a display panel and a parallax barrier mounted to the display panel, on an outwardly facing side of the display panel facing an associated one of the plurality of passengers **14**. In an exemplary embodiment the parallax barrier that is mounted onto the transparent display **46** includes a plurality of parallel, vertical apertures, that divide the image displayed such that a left eye and a right eye of a passenger **14** viewing the autostereoscopic display see different portions of the displayed image and the passenger **14** perceives a three-dimensional image.
(23) In an exemplary embodiment, the parallax barrier that is mounted onto the transparent display **46** is selectively actuatable by a controller adapted to switch between having the parallax barrier off, wherein the parallax barrier is completely transparent, and the viewing passenger **14** sees images displayed on the transparent display **46** as two-dimensional images, and having the parallax barrier on, wherein the viewing passenger **14** sees the images displayed on the transparent display **46** as a three-dimensional images.
(24) When the parallax barrier is actuated, each of the left and right eyes of the viewing passenger **14** only see half of the displayed image, therefore, the resolution of the three-dimensional image is reduced. To improve resolution, in one exemplary embodiment, the controller is configured to implement time-multiplexing by alternately turning the parallax barrier on and off. Time-multiplexing requires the system **10** to be capable of switching the parallax barrier on and off fast enough to eliminate any perceptible image flicker by the viewing passenger **14**. Liquid crystal displays are particularly suitable for such an application.
(25) Referring to FIG. **3**, the image chamber **16** includes transparent portions **52**, **54** to allow the passengers **14** to see their associated reflector **20**, **24**, **28**, **30**. As shown, the image chamber **16** includes a first transparent portion **52** that is adapted to allow the first image **12**A reflected by the first reflector **20** to pass from the image chamber **16** outward toward the first passenger **14**A, as indicated by arrows **34** in FIG. **1**. Further, the image chamber **16** includes a second transparent portion **54** that is adapted to allow the second image **14**B reflected by the second reflector **24** to pass from the image chamber **16** outward toward the second passenger **14**B, as indicated by arrows **40** in FIG. **1**.
(26) The image chamber **16** further includes solid portions **56**, **58** that are adapted to prevent light from entering the image chamber **16** behind the first and second reflectors **20**, **24**. The image chamber **16** functions much like a Pepper's Ghost Chamber, wherein the image of an object is perceived by a viewer within a reflective surface adjacent the actual image. As discussed above, in the present disclosure, the image presented by a display **18**, **22** which is not within view of a passenger **14**, is reflected by a reflector **20**, **24**, **28**, **30** to the passenger **14**A, **14**B, **14**C, **14**D such that the passenger “sees” the image within the image chamber **16** and perceives the image **12** to be floating behind the reflective surface of the reflector **20**, **24**, **28**, **30**. If the image chamber **16** behind the reflectors **20**, **24**, **28**, **30** is exposed to ambient light, the image will not be viewable by the passengers **14**. Thus, solid portions **56**, **58** of the image chamber **16** are adapted to prevent light from entering the image chamber **16** behind the first and second reflectors **20**, **24**. Referring to FIG. **3**, the image chamber **16** includes solid overlapping panels **56**, **58** that are adapted to prevent light from entering the image chamber **16** behind the first and second reflectors **20**, **24**.
(27) Referring to FIG. **4**, in an exemplary embodiment, the system **10** is selectively moveable vertically up and down along a vertical central axis **60**, as indicated by arrow **62**. Further, each display **18**, **22** and the associated reflector **20**, **24**, **28**, **30** are unitarily and selectively rotatable about the vertical central axis **60**, as shown by arrows **64**. This allows the system **10** to adjust to

varying locations of the passengers **14** within the vehicle compartment **26**.
(28) Referring to FIG. **5**, the fist reflector **20** and the first display **18** are rotatable about the vertical central axis **60**, as indicated by arrow **66**. The second reflector **24** and the second display **22** are rotatable about the vertical central axis **60**, as indicated by arrow **68**. As shown in FIG. **3**, the first and second passengers **14**A, **14**B are sitting directly across from one another, and the first reflector **20** and first display **18** are positioned 180 degrees from the second reflector **24** and second display **22**. As shown in FIG. **5**, the position of the head of the second passenger **14**B has moved, and the second reflector **24** and the second display **22** have been rotated an angular distance **70** to ensure the second passenger **14**B perceives the image **12** from the second display **22** and the second reflector **24**.
(29) In an exemplary embodiment, the image chamber **16** includes first solid panels **56** positioned adjacent the first reflector **20** on either side and adapted to move unitarily with the first reflector **20** and the first display **18** as the first reflector **20** and the first display **18** rotate about the vertical central axis **60**. Second solid panels **58** are positioned adjacent the second reflector **24** on either side and are adapted to move unitarily with the second reflector **24** and the second display **22** as the second reflector **24** and the second display **22** rotate about the vertical central axis **60**. The first solid panels **56** overlap the second solid panels **58** to allow relative movement of the first solid panels **56** relative to the second solid panels **58** and to ensure that ambient light is blocked from entering the image chamber **16** behind the first and second reflectors **20**, **24** at all times.
(30) In an exemplary embodiment, each of the displays **18**, **22** and associated reflectors **20**, **24**, **28**, **30** are equipped with head tracking capability, wherein an orientation of each display **18**, **22** and associated reflector **20**, **24**, **28**, **30** changes automatically in response to movement of a head and eyes of a passenger **14** detected by a monitoring system **72**. Monitoring systems **72** within a vehicle include sensors **74** that monitor head and eye movement of a driver/passenger within the vehicle.
(31) In an exemplary embodiment, the system **10** includes first sensors **74** adapted to monitor a position of a head and eyes of the first passenger **14**A. The first sensors **74** may include camera and motion sensors adapted to detect the position and movement of the first passenger's head and eyes. As shown, the first sensors **74** include a camera oriented to monitor the position and movement of the head and eyes of the first passenger **14**A. The first display **18** and first reflector **20** are adapted to rotate in response to movement of the head and eyes of the first passenger **14**A. The system **10** further includes second sensors **76** adapted to monitor a position of a head and eyes of the second passenger **14**B. The second sensors **76** may include camera and motion sensors adapted to detect the position and movement of a passenger's head and eyes. As shown, the second sensors **76** include a camera oriented to monitor the position and movement of the head and eyes of the second passenger **14**B. The second display **22** and second reflector **24** are adapted to rotate about the vertical central axis **60** in response to movement of the head and eyes of the second passenger **14**B.
(32) Referring to FIG. **6**, a controller **78** of the monitoring system **72** receives information from the first sensors **74**, and in response to detection of head/eye movement by the first passenger **14**A, actuates a first motor **80** adapted to rotate the first reflector **20** and first display **18** about the vertical central axis **60**. Further, the controller **78** of the monitoring system **72** receives information from the second sensors **76**, and in response to detection of head/eye movement by the second passenger **14**B, actuates a second motor **82** adapted to rotate the second reflector **24** and second display **22** about the vertical central axis **60**.
(33) The controller **78** is a non-generalized, electronic control device having a preprogrammed digital computer or processor, memory or non-transitory computer readable medium used to store data such as control logic, software applications, instructions, computer code, data, lookup tables, etc., and a transceiver [or input/output ports]. computer readable medium includes any type of medium capable of being accessed by a computer, such as read only memory (ROM), random access memory (RAM), a hard disk drive, a compact disc (CD), a digital video disc (DVD), or any other type of memory. A “non-transitory” computer readable medium excludes wired, wireless,

optical, or other communication links that transport transitory electrical or other signals. A non-transitory computer readable medium includes media where data can be permanently stored and media where data can be stored and later overwritten, such as a rewritable optical disc or an erasable memory device. Computer code includes any type of program code, including source code, object code, and executable code.

(34) In addition to rotation of the first display **18** and first reflector **20** and the second display **22** and second reflector **24**, the system **10** is adapted to move up and down along the vertical central axis **60** in response to movement of the head and eyes of the first passenger **14**A and movement of the head and eyes of the second passenger **14**B. The controller **78** of the monitoring system **72** receives information from the first sensors **74** and the second sensors **76**, and in response to detection of head/eye movement by the first and second passengers **14**A, **14**B, actuates a third motor **84** adapted to raise and lower the system **10** along the vertical central axis **60** to maintain optimal vertical position of the system **10** relative to the passengers **14**. Preferences may be set within the system **10** such that the system **10** maintains optimal vertical positioning relative to a designated one of the plurality of passengers **14**, or alternatively, preferences can be set such that the system **10** maintains a vertical position taking into consideration some or all of the plurality of passengers **14**.

(35) In an exemplary embodiment, the monitoring system **72** is adapted to monitor the position of a head and eyes of each one of the plurality of passengers **14**, wherein, for each of the plurality of passengers **14**, the system **10** is adapted to display information at a specific location on the transparent display **46** based on a position of the head and eyes of the passenger **14**. In another exemplary embodiment, for each of the plurality of passengers **14**, the system **10** is adapted to display information at a specific location on the transparent display **46** based on the position of the head and eyes of the passenger **14** relative to the perceived image **12** within the image chamber **16**, such that, for each of the plurality of passengers **14**, information displayed on the transparent display **46** is properly positioned relative to the perceived image **12** within the image chamber **16**.

(36) Referring to FIG. **7**, in a schematic view of a passenger **14** an associated transparent display **46** and a floating image **12**, the passenger **14** perceives the floating image **12** at a distance behind the transparent display **46**. The transparent display **46** displays information related to the floating image **12** at a proper location on the transparent display **46** so the passenger **14** sees the information at a proper location relative to the floating image **12**. As shown in FIG. **7**, the floating image **12** is of a skyline, and more specifically, of three buildings, a first building **86**, a second building **88**, and a third building **90**. The transparent display **46** displays first building information **92**, second building information **94** and third building information **96**.

(37) The first building information **92** appears in a text box and may contain information about the first building **86** as well as the option of allowing the passenger **14** to touch the first building information **92** text box to acquire additional information about the first building **86**. For example, the first building information **92** text box may contain the name of the first building **86** and the street address. The passenger **14** may opt to touch the first building information **92** text box, wherein additional information will appear on the transparent display **46**, such as the date the first building **86** was built, what type of building (office, church, arena, etc.), or statistics such as height, capacity, etc. The second building information **94** and the third building information **96** also appear in text boxes that contain similar information and the option for the passenger **14** to touch the second or third building information **94**, **96** text boxes to receive additional information about the second and third buildings **88**, **90**.

(38) The monitoring system **72** tracks the position of the passenger's **14** head **14**H and eyes **14**E and positions the first, second and third building information **92**, **94**, **96** text boxes at a location on the transparent display **46**, such that when the passenger **14** looks at the floating image **12** through the reflector **20**, **24**, **28**, **30** and the transparent display **46**, the passenger **14** sees the first, second and third building information **92**, **94**, **96** text boxes at the proper locations relative to the floating

image **12**. For example, the transparent display **46** positions the first building information **92** in the passenger's line of sight, as indicated by dashed line **98**, such that the first building information **92** is perceived by the passenger **14** at a location immediately adjacent the first building **86**, as indicated at **100**. Correspondingly, the transparent display positions the second building information **94** in the passenger's line of sight, as indicated by dashed line **102**, and the third building information **96** in the passenger's line of sight, as indicated by dashed line **104**, such that the second and third building information **94**, **96** is perceived by the passenger **14** at a location superimposed on the building, in the case of the second building **88**, as indicated at **106**, and at a location immediately adjacent the building, in the case of the third building **90**, as indicated at **108**.

(39) The monitoring system **72** continuously tracks movement of the head **14**H and eyes **14**E of the passenger **14** and adjusts the position that the first, second and third building information **92**, **94**, **96** are displayed on the transparent display **46** to ensure that the passenger **14** always perceives the first, second and third building information **92**, **94**, **96** at the proper locations **100**, **106**, **108** relative to the floating image **12**.

(40) In an exemplary embodiment, the system **10** is adapted to accept input from a passenger **14** based solely on contact between the passenger **14** and the transparent display **46**. For example, when a passenger **14** reaches out to touch a finger-tip to the transparent display **46**, the transparent display **46** takes the input based solely on the point of contact between the tip of the finger of the passenger **14** and the transparent display **46**.

(41) In another exemplary embodiment, the system **10** is adapted to accept input from a passenger **14** based on contact between the passenger **14** and the transparent display **46** and based on the location of a point of contact between the passenger **14** and the transparent display **46** relative to the perceived image **12**. For example, the monitoring system **72** tracks the movement and position of the passenger's **14** eyes **14**E and head **14**H. The transparent display **46** displays information that is perceived by the passenger **14** relative to the floating image **12**, as discussed above. When the passenger **14** touches the transparent display **46**, the passenger **14** perceives that they are touching the floating image **12**. The system **10** uses parallax compensation to correlate the actual point of contact between the finger-tip of the passenger **14** on the transparent display **46** to the location on the floating image **12** that the passenger **14** perceives they are touching.

(42) The system **10** may display, on the transparent display **46**, multiple different blocks of annotated information relative to a floating image **12**. As the passenger's **14** head **14**H and eyes **14**E move, the passenger's head **14**H and eyes **14**E will be positioned at a different distance and angle relative to the transparent display **46**, thus changing the perceived location of displayed information relative to the image **12**. By using parallax compensation techniques, such as disclosed in U.S. Pat. No. 10,318,043 to Seder, et al., hereby incorporated by reference herein, the system **10** ensures that when the passenger **14** touches the transparent display **46**, the system **10** correctly identifies the intended piece of annotated information that the passenger **14** is selecting.

(43) In another exemplary embodiment, the system **10** is adapted to accept input from a passenger **14** based on gestures made by the passenger **14** where the passenger **14** does not touch the transparent display **46**. For example, when the passenger **14** moves a hand, or points to an object that is displayed on the transparent display **46** or to an object within the vehicle compartment **26** or outside of the vehicle compartment **26**.

(44) Referring again to FIG. **1**, in an exemplary embodiment, the system includes a first gesture sensor **110** adapted to monitor position and movement of arms, hands and fingers **114** of the first passenger **14**A and to gather data related to gestures made by the first passenger **14**A. The first gesture sensor **110** may include a camera and motion sensors adapted to detect the position and movement of the first passenger's arms, hands and fingers. As shown, the first gesture sensor **110** includes a camera oriented to monitor the position and movement of the arms, hands and fingers of the first passenger **14**A. Further, the system **10** includes a second gesture sensor **112** adapted to monitor position and movement of arms, hands and fingers of the second passenger **14**B and to

gather data related to gestures made by the second passenger **14**B. The second gesture sensor **112** may include a camera and motion sensors adapted to detect the position and movement of the second passenger's arms, hands and fingers. As shown, the second gesture sensor **112** includes a camera oriented to monitor the position and movement of the arms, hands and fingers of the second passenger **14**B.
(45) The system **10** uses data collected by the first and second gesture sensors **110**, **112** to identify gestures made by the passengers **14**A, **14**B within the vehicle compartment **26**. A system controller will use computer learning algorithms and parallax compensation techniques to interpret such gestures and identify input data, such as when a passenger **14** is pointing to an object outside the vehicle compartment **26**.
(46) As mentioned, a system **10** in accordance with the present disclosure may be adapted to accommodate any suitable number of passengers **14**. Referring to FIG. **8**, a system **210** is shown wherein an image chamber **216** includes a display **218** and reflector **220** adapted to provide a displayed image within the image chamber **216** for a single passenger **14**. The image chamber **216** and a transparent display **246** of the system **210** are semi-circle shaped.
(47) A system of the present disclosure offers several advantages. These include providing a floating image that is perceived by the passengers at a centrally location position within the vehicle compartment. This provides a camp-fire like viewing atmosphere where the passengers can all view a common floating image, or each passenger can view a unique floating image. Further, a system in accordance with the present disclosure provides the ability to display annotations and information not embedded within the virtual image and to ensure such annotations and information are perceived by a passenger at a proper location relative to the virtual image and in a plane between the passenger and the floating image. The system also allows a passenger to interact with the virtual image via the touch screen passenger interface and uses parallax compensation to ensure the system correctly correlates passenger input via the passenger interface to annotations and information displayed along with the virtual image.
(48) The description of the present disclosure is merely exemplary in nature and variations that do not depart from the gist of the present disclosure are intended to be within the scope of the present disclosure. Such variations are not to be regarded as a departure from the spirit and scope of the present disclosure.

Claims

1. A system for generating a centrally located floating three-dimensional image display for at least one passenger positioned within a vehicle, comprising: an image chamber including: at least one display adapted to project an image; and at least one reflector, one of the at least one reflector individually associated with each one of the at least one display and one of the at least one passenger; and a transparent touch screen display positioned between the at least one reflector and the at least one passenger and adapted to allow the at least one passenger to provide input to the system; each of the at least one reflector adapted to receive an image from the associated one of the at least one display and to reflect the image to the associated one of the at least one passenger, wherein, the associated one of the at least one passenger perceives the image floating at a central location within the vehicle; and the transparent touch screen display adapted to: display information to the at least one passenger within an image plane positioned in front of the perceived image floating at the central location within the vehicle; accept input from the at least one passenger based on a location of a point of contact between the at least one passenger and the transparent touch screen display relative to the perceived image floating at the central location within the vehicle; and correlate, using parallax compensation, an actual point of contact between the at least one passenger and the transparent touch screen display to a location on the perceived image floating at the central location within the vehicle that the at least one passenger perceives

they are touching.
2. The system of claim 1, wherein the image chamber further includes: transparent portions adapted to allow the image reflected by each of the at least one reflector to pass from the image chamber outward toward the associated one of the at least one passenger; and solid portions adapted to prevent light from entering the image chamber behind the at least one reflector.
3. The system of claim 1, wherein the transparent touch screen display is positioned between the eyes of the at least one passenger and the perceived image floating at the central location within the vehicle.
4. The system of claim 1, wherein the system is selectively moveable vertically up and down along a vertical central axis, and each of the at least one display and the associated one of the at least one reflector are selectively rotatable about the vertical central axis.
5. The system of claim 4, further including sensors adapted to monitor a position of a head and eyes of each of the at least one passenger, wherein the system is adapted to move up and down along the vertical central axis in response to movement of the head and eyes of the associated one of the at least one passenger, and each of the at least one display and the associated one of the at least one reflector are adapted to rotate in response to movement of the head and eyes of the associated one of the at least one passenger.
6. The system of claim 1, wherein the transparent touch screen display is an organic light-emitting diode.
7. The system of claim 1, further including at least one gesture sensor adapted to gather information related to gestures made by the at least one passenger, wherein, the system is adapted to receive input from the at least one passenger via data collected by the at least one gesture sensor.
8. The system of claim 1, wherein the system is mounted to and supported by one of a roof within the vehicle and a floor within the vehicle.
9. The system of claim 1, wherein the transparent touch screen display is a beam splitter.
10. A system for generating a centrally located floating three-dimensional image display for a plurality of passengers positioned within a vehicle, comprising: an image chamber including: a first display adapted to project a first image; a first reflector individually associated with the first display and a first one of the plurality of passengers; a second display adapted to project a second image; and a second reflector individually associated with the second display and a second one of the plurality of passengers; and a transparent touch screen display positioned between the first reflector and the first passenger, and between the second reflector and the second passenger and adapted to allow the first and second passengers to provide input to the system; the first reflector adapted to receive the first image from the first display and to reflect the first image to the first passenger, wherein the first passenger perceives the first image floating at a central location within the image chamber, and the second reflector adapted to receive the second image from the second display and to reflect the second image to the second passenger, wherein, the second passenger perceives the second image floating at the central location within the image chamber; and the transparent touch screen display adapted to: display information to the first and second passengers within an image plane positioned in front of the perceived first and second images floating at the central location within the image chamber; accept input from one of the first and second passengers based on a location of a point of contact between the one of the first and second passengers and the transparent touch screen display relative to the perceived image floating at the central location within the image chamber; and correlate, using parallax compensation, an actual point of contact between the one of the first and second passengers and the transparent touch screen display to a location on the perceived image floating at the central location within the image chamber that the one of the first and second passengers perceives they are touching.
11. The system of claim 10, wherein the image chamber further includes: a first transparent portion adapted to allow the first image reflected by the first reflector to pass from the image chamber outward toward the first passenger; a second transparent portion adapted to allow the second image

reflected by the second reflector to pass from the image chamber outward toward the second passenger; and solid portions adapted to prevent light from entering the image chamber behind the first and second reflectors.

12. The system of claim 10, wherein the transparent touch screen display is positioned between eyes of the first passenger and the first image floating at the central location within the image chamber, and between eyes of the second passenger and the second image floating at the central location within the image chamber.

13. The system of claim 12, wherein the transparent touch screen display includes a transparent cylindrical touch screen.

14. The system of claim 10, wherein the system is selectively moveable vertically up and down along a vertical central axis, the first display and the first reflector are unitarily and selectively rotatable about the vertical central axis, and the second display and the second reflector are unitarily and selectively rotatable about the vertical central axis.

15. The system of claim 14, further including first sensors adapted to monitor a position of a head and eyes of the first passenger, wherein, the first display and first reflector are adapted to rotate in response to movement of the head and eyes of the first passenger, and second sensors adapted to monitor a position of a head and eyes of the second passenger, wherein, the second display and the second reflector are adapted to rotate in response to movement of the head and eyes of the second passenger, the system adapted to move up and down along the vertical axis in response to movement of the head and eyes of the first passenger and movement of the head and eyes of the second passenger.

16. The system of claim 10, wherein the transparent touch screen display is an organic light-emitting diode.

17. The system of claim 10, further including a first gesture sensor adapted to gather information related to gestures made by the first passenger, and a second gesture sensor adapted to gather information related to gestures made by the second passenger, wherein, the system is adapted to receive input from the first and second passengers via data collected by the first and second gesture sensors.

18. The system of claim 10, wherein the system is mounted to and supported by one of a roof within the vehicle and a floor within the vehicle.

19. A system for generating a centrally located floating three-dimensional image display for a plurality of passengers positioned within a vehicle, comprising: an image chamber including: a first display adapted to project a first image; a first reflector individually associated with the first display and a first one of the plurality of passengers; a first transparent portion adapted to allow the first image reflected by the first reflector to pass from the image chamber outward toward the first passenger; a second display adapted to project a second image; and a second reflector individually associated with the second display and a second one of the plurality of passengers; a second transparent portion adapted to allow the second image reflected by the second reflector to pass from the image chamber outward toward the second passenger; and solid portions adapted to prevent light from entering the image chamber behind the first and second reflectors; and a transparent touch screen display positioned between eyes of the first passenger and the first reflector, and between eyes of the second passenger and the second reflector and adapted to allow the first and second passengers to provide input to the system; the first reflector adapted to receive the first image from the first display and to reflect the first image to the first passenger, wherein the first passenger perceives the first image floating at a central location within the image chamber, and the second reflector adapted to receive the second image from the second display and to reflect the second image to the second passenger, wherein, the second passenger perceives the second image floating at the central location within the image chamber; and the transparent touch screen display adapted to: display information to the first and second passengers within an image plane positioned in front of the perceived first and second images floating at the central location within the image

chamber; accept input from one of the first and second passengers based on a location of a point of contact between the one of the first and second passengers and the transparent touch screen display relative to the perceived image floating at the central location within the image chamber; and correlate, using parallax compensation, an actual point of contact between the one of the first and second passengers and the transparent touch screen display to a location on the perceived image floating at the central location within the image chamber that the one of the first and second passengers perceives they are touching.

20. The system of claim 19, wherein the system is selectively moveable vertically up and down along a vertical central axis, the first display and the first reflector are unitarily and selectively rotatable about the vertical central axis, and the second display and the second reflector are unitarily and selectively rotatable about the vertical central axis; the system further including: first sensors adapted to monitor a position of a head and eyes of the first passenger, wherein, the first display and first reflector are adapted to rotate in response to movement of the head and eyes of the first passenger, and second sensors adapted to monitor a position of a head and eyes of the second passenger, wherein, the second display and the second reflector are adapted to rotate in response to movement of the head and eyes of the second passenger, the system adapted to move up and down along the vertical axis in response to movement of the head and eyes of the first passenger and movement of the head and eyes of the second passenger; and a first gesture sensor adapted to gather information related to gestures made by the first passenger, and a second gesture sensor adapted to gather information related to gestures made by the second passenger, wherein, the system is adapted to receive input from the first and second passengers via data collected by the first and second gesture sensors.