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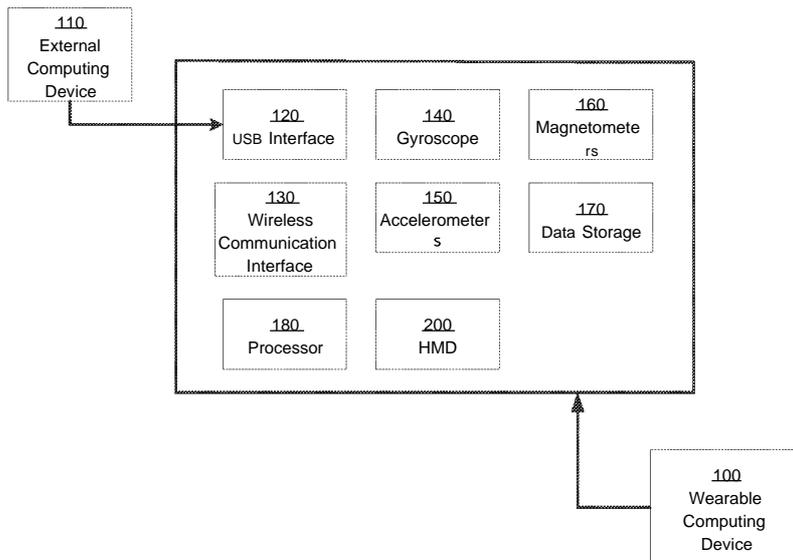
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(54) **Title:** MENU NAVIGATION IN A HEAD-MOUNTED DISPLAY

FIG. 1



(57) **Abstract:** A wearable computing device includes a head-mounted display (HMD) that generates a virtual reality environment. Through the generation and tracking of positional data, a focal point may be tracked with respect to one or menu navigation elements. Following the fixated positioning of the focal point over the menu navigation element for a predetermined amount of time, a process corresponding to the menu navigation element is executed.



## MENU NAVIGATION IN A HEAD-MOUNTED DISPLAY

### BACKGROUND OF THE INVENTION

#### Field of Invention

The present invention generally relates to wearable virtual reality (VR) computing devices having a head-mounted display (HMD). More specifically, the present invention relates to utilizing the field of view in the HMD to implement menu control functionality.

#### Description of the Related Art

Wearable VR systems integrate various elements such as input devices, sensors, detectors, image displays, and wireless communication components as well as image and audio processors. By placing an image display element close to the eyes of a wearer, an artificial image can be made to overlay the view of the real world or to create an independent reality all its own. Such image display elements are incorporated into systems also referred to as head-mounted displays (HMDs). Depending upon the size of the display element and the distance to the eyes of the wearer, artificial images provided on the display may fill or nearly fill the field of view of the wearer.

VR systems incorporating an HMD are mobile and lightweight while allowing for communication and interaction with a virtual environment. Such systems are generally lacking, however, in that they still require use of an independent controller for navigation of the virtual environment. In this sense, most HMDs are little more than goggles allowing for entry into a VR environment. There is a need in the art for navigation and control of a VR environment without introducing an independent controller device.

## SUMMARY OF THE CLAIMED INVENTION

Embodiments of the present invention include systems and methods for menu navigation in a head-mounted display. Positional data related to the head-mounted display may be generated. The position of a focal point may be tracked. The focal point may be determined to be within an operational range of a menu navigation element. A fixation timer that corresponds to the navigation element may be executed to count down a predetermined period of time when the focal point is determined to be within the operational range of the menu navigation element. Upon expiration of the predetermined period of time, a function corresponding to the navigation element may be implemented.

Methods for menu navigation in a head-mounted display may be provided. Such methods may include generating positional data of the head-mounted display via a sensor, tracking a position of a focal point of the head-mounted display within a virtual environment that includes a menu navigation element, determining that the focal point is within an operational range of the menu navigation element, executing a fixation timer corresponding to the navigation element that counts down a predetermined amount of time when the focal point is within the operational range of the menu navigation element, and implementing a corresponding function of the navigation element when the predetermined amount of time has expired.

Systems for menu navigation in a head-mounted display may include at least one of a gyroscope, magnetometer, and an accelerometer that generate positional data, a head-mounted display including at least one lens to display a focal point in a virtual environment that includes a menu navigation element, and a processor that executes instructions stored in memory to process the positional data to track the position of the focal point within the virtual environment, to determine that the focal point is within an operational range of the menu navigation element, to execute a fixation timer corresponding to the navigation element that counts down a predetermined amount of time when the focal point is within the operational range of the menu navigation element, and to execute a functionality associated with the

menu navigation element upon expiration of the predetermined amount of time as indicated by the fixation timer.

Additional embodiments of the present invention provides a non-transitory computer-readable storage medium having embodied thereon a program. The program is executable by a processor to perform a method for menu navigation in a head-mounted display. The method includes generating positional data, tracking the position of a focal point and determining that the focal point is within an operational range of a menu navigation element. A fixation timer is that corresponds to the navigation element is executed. A corresponding function of the navigation element is implemented when the fixation timer expires.

**BRIEF DESCRIPTION OF THE DRAWINGS**

FIGURE 1 illustrates a block diagram of an exemplary wearable computing device.

FIGURE 2A illustrates an HMD that completely immerses a wearer in a virtual reality environment.

FIGURE 2B illustrates an HMD that allows for generation of VR information while maintaining perception of the real world.

FIGURE 3 illustrates an exemplary navigation menu displayed on lens display of HMD.

FIGURE 4A illustrates the use of focal point to effectuate a visual element in a navigation menu whereby the corresponding operation of a virtual button has not been activated.

FIGURE 4B illustrates the use of focal point to effectuate a visual element in a navigation menu whereby a region associated with the focal point and virtual button are activating a corresponding function.

FIGURE 4C illustrates the use of focal point to effectuate a visual element in a navigation menu whereby the focal point is directly activating a corresponding function of a virtual button.

FIGURE 5 illustrates an exemplary method for menu selection in a VR environment.

## DETAILED DESCRIPTION

Embodiments of the present invention include systems and methods for menu navigation in a head-mounted display. Positional data related to the head-mounted display may be generated. The position of a focal point may be tracked. The focal point may be determined to be within an operational range of a menu navigation element. A fixation timer that corresponds to the navigation element may be executed to count down a predetermined period of time when the focal point is determined to be within the operational range of the menu navigation element. Upon expiration of the predetermined period of time, a function corresponding to the navigation element may be implemented.

FIGURE 1 illustrates a block diagram of an exemplary wearable virtual reality system **100**. In communication with an external computing device **110**, wearable virtual reality system **100** may include a USB interface **120**, wireless communication interface **130**, gyroscope **140**, accelerometer **150**, magnetometer **160**, data storage **170**, processor **180**, and head-mounted display (HMD) **200**.

Head-mounted display (HMD) **200** allows its wearer to observe real-world surroundings, a displayed computer generated image, or a combination of the two. HMD **200** may include a see-through display in some embodiments. The wearer of wearable co virtual reality system **100** may be able to look through HMD **200** in such an embodiment and observe a portion of the real-world environment notwithstanding the presence of the wearable virtual reality system **100**. HMD **200** in a further embodiment may be operable to display images that are superimposed on the field of view to provide an "augmented reality" experience. Some of the images displayed by HMD **200** may be superimposed or appear in relation to particular objects in the field of view. In a still further embodiment, HMD **200** may be a completely virtual environment whereby the wearer of the wearable virtual reality system **100** is isolated from any visual contact with the real world.

The displayed image may include graphics, text, and/or video; audio may be provided through a corresponding audio device. The images displayed by the HMD may be part of an interactive user interface and include menus, selection boxes,

navigation icons, or other user interface features that enable the wearer to invoke functions of the wearable computing device or otherwise interact with the wearable computing device. The form factor of HMD 200 may be that of eyeglasses, goggles, a helmet, a hat, a visor, a headband, or in some other form that can be supported on or from the head of the wearer.

To display a virtual image to the wearer, the HMD may include an optical system with a light source such as a light-emitting diode (LED) that illuminates a display panel. The display panel may encompass a liquid crystal display panel (LCD). The display panel may generate light patterns by spatially modulating the light from the light source, and an image former forms a virtual image from the light pattern. Alternatively, the panel may be liquid crystal on silicon (LCOS) whereby a liquid crystal layer may be situated on top of a silicon backplane.

The HMD in an exemplary embodiment includes a 7 inch screen with non-overlapping stereoscopic 3D images whereby the left eye sees extra area to the left and the right eye sees extra area to the right. The HMD attempts to mimic normal human vision, which is not 100% overlapping. The field of view in an exemplary embodiment is more than 90 degrees horizontal (110 degrees diagonal) thereby filling approximately the entire field of view of the view such that the real world may be completely blocked out to create a strong sense of immersion.

An embodiment may utilize 1280×800 (16:10 aspect ratio) thereby allowing for an effective of 640×800, 4:5 aspect ratio per eye. In an embodiment that does not allow for complete overlap between the eyes, the combined horizontal resolution is effectively greater than 640. The displayed image for each eye is pin cushioned thereby generating a spherical-mapped image for each eye.

HMD 200 may communicate with external computing device(s) 110. External computing device(s) 110 are inclusive of application servers, databases, and other external computing components known in the art, including standard hardware computing components such as network and media interfaces, non-transitory computer-readable storage (memory), and processors for executing instructions or accessing information that may be stored in memory.

Wearable virtual reality system **100** may in some instances be physically connected to external computing device(s) **110**. Such a connection may be implemented by way of a USB interface **120**, which may be used to send data to and receive data from an external computing device **110** by way of a USB-compliant cabling. USB interface **120** may also be used to power the wearable virtual reality system **100** thereby potentially negating the need for an external power supply and any power cabling associated with the same. In some instances, a further power adapter (not shown) may be necessary to implement power by way of the USB interface **120**. It should be understood that reference to USB is exemplary as other types of interfaces may be used including but not limited to FireWire, Lightning, as well as other cabled connection standards such as HDMI and DVI.

Wearable virtual reality system **100** of FIGURE 1 includes a wireless communication interface **130**. Wireless communication interface **130** may be used for wirelessly communicating with external computing device(s) **110**. Wireless communication interface **130** may also be used for communicating with other wearable computing devices **100**. Wireless communication interface **130** may utilize any number of wireless communication standards that support bi-directional data exchange over a packet-based network such as the Internet. Exemplary communication standards include CDMA, GSM/GPRS, 4G cellular, WiMAX, LTE, and 802.11 (WiFi).

Wearable virtual reality system **100** may include one or more of three-dimensional axis gyroscopes **140**, accelerometers **150**, and magnetometers **160**. Gyroscope **140** may be utilized to measure orientation based on the principles of angular momentum. Accelerometer **150** may be used to detect magnitude and direction of acceleration as a vector quantity. This result can be used to sense orientation because direction of weight changes, coordinate acceleration correlated to g-force or a change in g-force, and vibration, shock, and falling in a resistive medium by way of a change in proper acceleration. Magnetometers **160** may be used to identify disturbances in a magnetic field relative the wearable virtual reality system **100**. Magnetometer **160** can assist in the identification of true north for GPS and compass applications as well as assist with touchless or camera-less gesture input. By

utilizing data generated from the foregoing, absolute head orientation tracking without drift relative to the earth may be calculated. Latency tracking may operate at approximately 1000 Hz to decrease response time and increase perceived realism. The displays of wearable virtual reality system **100** may be adjusted to allow the individual displays to be moved further or closer to the eyes of the wearer.

Wearable virtual reality system **100** may operate by way of the execution of non-transitory computer readable instructions stored in data storage **170**, where execution occurs through operation of processor **180**. While FIGURE 1 illustrates data storage **170** and processor **180** as being present at wearable virtual reality system **100**, such elements may be located in external computing device(s) **110** or in some instances, with executable operations distributed between the two. Processor **180** and executable instructions at data storage **170** may also control various aspects of USB interface **120**, wireless interface **130**, gyroscopes **140**, accelerometers **150**, and magnetometers **160**.

FIGURE 2A illustrates an HMD **200** that completely immerses a wearer in a virtual reality environment. While FIGURE 2A is illustrated as immersive goggles, other form factors are possible and envisioned. The operation of elements in FIGURE 2A are the same as those discussed in the context of FIGURE 2B. FIGURE 2A includes head-mounted support **210** that allows for wearable virtual reality system **100** (including HMD **200**) to be positioned on the head of a wearer. HMD **200** further includes lens displays **220A** and **220B** that may be of LCD or LCOS construction as described above. Lens displays **220A** and **220B** may be an integrated part of wearable virtual reality system **100**.

The manufacture of wearable virtual reality system **100** may allow for integration of components like those illustrated in FIGURE 1 and various component interconnects to be internally integrated. Other components may be situated on the exterior of wearable virtual reality system **100** to allow for more ready access or physical connections to external computing device(s) **110**. An embodiment of wearable virtual reality system **100** may include a microphone to allow for voice communication with other individuals utilizing wearable virtual reality system **100** or to allow for certain hands free control of the system **100**.

FIGURE 2B illustrates an HMD 200 that allows for generation of virtual reality information while maintaining perception of the real world. Such dual perception is provided for by not completely immersing the wearer within the confines of the virtual environment (*i.e.*, the real world can still be seen and perceived). While HMD 200 of FIGURE 2B is illustrated as a simple band other form factors are possible and envisioned. The operation of elements on FIGURE 2B are the same as those discussed in the context of FIGURE 2A.

FIGURE 3 illustrates an exemplary navigation menu 300 displayed on lens display 200 of HMD 200. Navigation menu 300 may include any variety of visual elements including virtual buttons 310, scroll bars 320, keys 330, or any other known elements for receiving input from a user. The navigation menu 300 may be defined in terms of one or more control instructions for controlling a software application executing on virtual wearable system 100. Particular visual elements of a navigation menu 300, such as a virtual button 310, may be associated with a particular control instruction, so that actuation of the virtual button may result in its associated control instruction be effectuated.

As noted above, wearable virtual reality system 100 includes one or more of axis gyroscopes 140, accelerometers 150, and magnetometers 160. Data generated by one or more of the foregoing components may be translated into selection or manipulation of one or more visual elements from navigation menu 300 and displayed by HMD 200. For example, by way of the user moving their head while wearing wearable virtual reality system 100, a point in space can be identified using the gyroscope 140, accelerometers 150, and magnetometers 160 to create a focal spot 340 in three-dimensional space in a manner similar to a mouse pointer in two-dimensional space that may be generated in the context of a desktop computer. Focal spot or pointer 340 may, but not necessarily, correspond to a line-of-sight 350 from the eye of a user vis-a-vis the lens 220 of HMD 200 (see inset of FIGURE 3).

By aligning focus spot 340 over various visual elements of navigation menu 300 and maintaining the positioning of the focal spot / pointer 340 over a particular visual element (*e.g.*, virtual button 310) for a particular period of time, the functionality of the focused-on element may be effectuated. It may not be sufficient

for focal point 340 to merely track over a virtual button 310, but instead remain fixated over the virtual button 310 or an area associated with the virtual button 310 for a predefined period of time (*e.g.*, three seconds). The pre-defined period of time may be set by a developer of a software application or controlled through a user preferences option that may be changed in the wearable virtual reality system 100 or the application software by the user of the system 100.

FIGURES 4A-4C illustrates the use of a focal point to effectuate a visual element in a navigation menu. Specifically, FIGURE 4A illustrates a focal point 340 not yet fixated on element 310 in a navigation menu. As such, the corresponding operation of a virtual button has not yet been activated. As shown in FIGURE 4A, focal point 340 includes an associated area 420 that extends the effect of maintaining focal point 340 over a particular point or area associated with said point. While illustrated as a circle in FIGURE 4A, the associated area 420 may also be a square, rectangle, or any other shape or configuration that extends the operative range of the focal point 340. Associated area 420 of focal point 340 may be visible, translucent, or invisible to the user. Associated area 420 in an instance of being visible or translucent may be of a color that sets off the area from the background of the virtual environment displayed on lens 220 such that the user has a clear understanding of the range of focal point 340 and associated area 420.

Virtual button 310 may also have an associated area (410) like that of the focal point 340. Like the focal point 340 and its associated area 420, the area may be of a different shape, size, color, or visibility, or translucency of virtual button 340 or virtual environment as displayed on lens 220 of HMD 200. The associated area 410 of virtual button 310 and the associated area 420 of focal point 340 may each individually be controlled by developer, default, or user settings, which may be changed through a user settings menu (not shown). Controllable functions include shape, size, visibility, translucency, as well as the aforementioned time period of fixation requires to activate the function of virtual menu 300.

FIGURE 4B illustrates a region 420 associated with the focal point 420 overlapping with virtual button 410, which effectuates a visual element in a navigation menu 300 and activates a corresponding function of the virtual button

**310.** Compared to FIGURE 4A, FIGURE 4B illustrates that the associated regions of focal point **340** and virtual button **310** now overlap as shown in highlighted area **430**. While a highlighted area is graphically illustrated in FIGURE 4B, this is for ease of illustration. It is not required that a highlighted area **430** appear on lens **220** but this may be a setting available for configuration by user and/or an application developer. Because the associated areas of focal point **340** and virtual button **310** are overlapping, the associating function of the virtual button **310** will be effectuated at the expiration of the pre-defined fixation time, the tolling of which may be controlled by an internal clocking function implemented through the processor-based execution of software responsible for the control of menu **300** and maintained in data storage **170**. Such an internal clocking function may be activated to count down from a pre-defined period of time or count up to the pre-defined period of time. Such counting may be set to occur only while there is overlap between focal point **340** and menu navigation element **310** (or associated areas **410** and **420** thereof). As such, if focal point **340** were to move away before the pre-defined period of time has expired, no function may be activated.

FIGURE 4C illustrates the use of focal point to effectuate a visual element in a navigation menu whereby the focal point is directly activating a corresponding function of a virtual button. Unlike FIGURE 4B, the associated areas **410** and **420** of virtual button **310** and focal point **340** are not being utilized. In FIGURE 4C, the focal point **340** is fixated directly over the virtual button **310**. At the expiration of the required period of fixation time, the associated function of the button will be implemented.

FIGURE 5 illustrates an exemplary method **500** for menu selection in a VR environment, which may be effectuated by execution of instructions stored in memory **170** by processor **180**. The method **500** of FIGURE 5 may be embodied as executable instructions in a non-transitory computer readable storage medium including but not limited to a CD, DVD, or non-volatile memory such as a hard drive. The instructions of the storage medium may be executed by a processor (or processors) to cause various hardware components of a computing device hosting or otherwise accessing the storage medium to effectuate the method. The steps

identified in FIGURE 5 (and the order thereof) are exemplary and may include various alternatives, equivalents, or derivations thereof including but not limited to the order of execution of the same.

In step 510, positional data may be generated based on movement of the head of a wearer of the wearable VR system 100. Positional data may be generated by one or more of axis gyroscopes 140, accelerometers 150, and magnetometers 160.

Data generated by one or more of the foregoing components may be translated into positional data of a focus spot or pointer 340 at step 520. That location of the of focus spot or pointer 340 may be displayed in the context of one or more visual elements from navigation menu 300 and displayed by HMD 200.

A determination is made at step 530 as to whether the focus spot or pointer 340 is currently located over a button or other element from a navigation menu 300. If a determination has been made from an analysis of the position of focus spot or pointer 340 that it is not located over an element from navigation menu 300, a further determination is made at step 540 as to whether an area associated with the focus spot or pointer is located over an element from navigation menu 300. If a determination is made that associated area of the focus spot or pointer is not located over an element from the navigation menu in step 540, a still further determination is made at step 550 as to whether an associated area of the focal point overlaps with an associated area of the element. If the determination remains no at step 550—as illustrated in FIGURE 4A—then the generation of positional data and tracking of position of the focal point continues at steps 510 and 520, respectively.

If the determination at step 530 is yes (as would correspond to FIGURE 4C) or at step 540 (as would correspond to FIGURE 4B), then a fixation timer begins to execute at step 560 to decide whether the focal point or its associated area remains over the navigational menu element for the predetermined period of time to invoke any functionality associated with that button or other element. As the timer counts down (or up) to the predetermined fixation time, an concurrent determination is continually made at step 570 as to whether there has been movement of the focal point or its associated area with respect to the navigational menu. If the focal point or associated area has changed such that the determinations of steps 530, 540, or 550

would now register "no," (*i.e.*, movement registers as a 'yes') then the timer stops and the generation of positional data and tracking of the focal point continues at steps 510 and 520, respectively. The change in position prior to expiration of the required fixation time correlates to intent of the user or wearer of system 100 not to invoke any corresponding menu functionality.

If, however, the determination is "no" as to movement of the focal point at step 570, then a still further determination is made at step 580 with respect to expiration of the pre-determined time period at step 580. If the pre-determined period has not yet been counted up or down to, then the loop consisting of steps 560, 570, and 580 continues until expiration of the fixation period has been achieved at which point the corresponding functionality of the menu executes at step 590 and method 500 ends.

The present invention may be implemented in an application that may be operable using a variety of devices. Non-transitory computer-readable storage media refer to any medium or media that participate in providing instructions to a central processing unit (CPU) for execution. Such media can take many forms, including, but not limited to, non-volatile and volatile media such as optical or magnetic disks and dynamic memory, respectively. Common forms of non-transitory computer-readable media include, for example, a floppy disk, a flexible disk, a hard disk, magnetic tape, any other magnetic medium, a CD-ROM disk, digital video disk (DVD), any other optical medium, RAM, PROM, EPROM, a FLASH EPROM, and any other memory chip or cartridge.

Various forms of transmission media may be involved in carrying one or more sequences of one or more instructions to a CPU for execution. A bus carries the data to system RAM, from which a CPU retrieves and executes the instructions. The instructions received by system RAM can optionally be stored on a fixed disk either before or after execution by a CPU. Various forms of storage may likewise be implemented as well as the necessary network interfaces and network topologies to implement the same.

While various embodiments have been described above, it should be understood that they have been presented by way of example only, and not

limitation. The descriptions are not intended to limit the scope of the invention to the particular forms set forth herein. Thus, the breadth and scope of a preferred embodiment should not be limited by any of the above-described exemplary embodiments. It should be understood that the above description is illustrative and not restrictive. To the contrary, the present descriptions are intended to cover such alternatives, modifications, and equivalents as may be included within the spirit and scope of the invention as defined by the appended claims and otherwise appreciated by one of ordinary skill in the art. The scope of the invention should, therefore, be determined not with reference to the above description, but instead should be determined with reference to the appended claims along with their full scope of equivalents.

**CLAIMS****WHAT IS CLAIMED IS:**

1. A method for menu navigation in a head-mounted display, the method comprising:
  - generating positional data of the head-mounted display;
  - tracking a position of a focal point of the head-mounted display, wherein the position of the focal point is tracked within a virtual environment that includes a menu navigation element;
  - determining that the focal point is within an operational range of the menu navigation element;
  - executing a fixation timer corresponding to the navigation element, wherein the fixation timer counts down a predetermined amount of time when the focal point is within the operational range of the menu navigation element; and
  - implementing a corresponding function of the navigation element upon expiration of the predetermined amount of time as indicated by the fixation timer.
2. The method of claim 1, wherein generating the positional data includes processing data from a gyroscope.
3. The method of claim 1, wherein generating positional data includes processing data from an accelerometer.
4. The method of claim 1, wherein generating positional data includes processing data from a magnetometer.

5. The method of claim 1, wherein the focal point comprises an associated area around the focal point, and wherein determining that the focal point is within the operational range of the menu navigation comprises determining that the associated area is within the operational range of the menu navigation element.

6. The method of claim 1, wherein the operational range of the menu navigation element comprises an associated area around the menu navigation element, and wherein determining that the focal point is within the operational range of the menu navigation comprises determining that the focal point is within the associated area.

7. The method of claim 1, wherein the focal point and the menu navigation element each includes an associated area, and wherein determining that the focal point is within the operational range of the menu navigation comprises determining that the associated area of the focal point overlaps the associated area of the menu navigation element.

8. The method of claim 1, wherein executing the fixation timer corresponding to the navigation element comprises determining whether the focal point has moved out of the operational range since the fixation timer began execution.

9. The method of claim 8, wherein executing the fixation timer corresponding to the navigation element further comprises confirming that the focal point remains within the operational range of the menu navigation element.

10. The method of claim 8, wherein executing the fixation timer corresponding to the navigation element further comprises confirming that an area associated with the focal point remains within the operational range of the menu navigation element.

11. The method of claim 8, wherein executing the fixation timer corresponding to the navigation element further comprises confirming that an area associated with the focal point continues to overlap an area associated with the menu navigation element.
12. The method of claim 1, further comprising changing an appearance of the focal point during the execution of the timer.
13. The method of claim 1, further comprising changing an appearance of the navigation element during execution of the timer.
14. The method of claim 1, further comprising changing an appearance of an area associated with the focal point during execution of the timer.
15. The method of claim 1, further comprising changing an appearance of an area associated with the navigation element during execution of the timer.
16. The method of claim 1, further comprising changing an appearance of the focal point and the navigation element during execution of the timer.
17. The method of claim 1, further comprising changing an appearance of the focal point and an area associated with the navigation element during execution of the timer.
18. The method of claim 1, further comprising changing an appearance of an area associated with the focal point and the navigation element during execution of the timer.

19. A non-transitory computer readable storage medium having embodied thereon a program, the program being executable by a processor to perform a method for menu navigation in a head-mounted display, the method comprising:

generating positional data of the head-mounted display;

tracking a position of a focal point of the head-mounted display, wherein the position of the focal point is tracked within a virtual environment that includes a menu navigation element;

determining that the focal point is within an operational range of the menu navigation element;

executing a fixation timer corresponding to the navigation element, wherein the fixation timer counts down a predetermined amount of time when the focal point is within the operational range of the menu navigation element; and

implementing a corresponding function of the navigation element upon expiration of the predetermined amount of time as indicated by the fixation timer.

20. A system for menu navigation, the system comprising:
- at least one of a gyroscope, magnetometer, and an accelerometer that generate positional data;
  - a head-mounted display including at least one lens to display a focal point in a virtual environment that includes a menu navigation element;
  - a processor that executes instructions stored in memory to:
    - process the positional data to track the position of the focal point within the virtual environment,
    - determine that the focal point is within an operational range of the menu navigation element,
    - execute a fixation timer corresponding to the navigation element, wherein the fixation timer counts down a predetermined amount of time when the focal point is within the operational range of the menu navigation element, and
    - execute a functionality associated with the menu navigation element upon expiration of the predetermined amount of time as indicated by the fixation timer.

**AMENDED CLAIMS**

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1. A method for menu navigation in a head-mounted display, the method comprising:
  - generating positional data of the head-mounted display;
  - displaying a focal point of the head-mounted display within a virtual environment;
  - tracking a position of the focal point of the head-mounted display, wherein the position of the displayed focal point is moved over one or more visual elements within the virtual environment;
  - determining that the displayed focal point is within an operational range of a menu navigation element in the virtual environment;
  - executing a fixation timer corresponding to the navigation element, wherein the fixation timer counts down a predetermined amount of time when the displayed focal point is within the operational range of the menu navigation element, and wherein the fixation timer stops counting when the focal point moves out of the operational range;
  - and
  - implementing a corresponding function of the navigation element upon expiration of the predetermined amount of time as indicated by the fixation timer.
2. The method of claim 1, wherein generating the positional data includes processing data from a gyroscope.
3. The method of claim 1, wherein generating positional data includes processing data from an accelerometer.
4. The method of claim 1, wherein generating positional data includes processing data from a magnetometer.

5. The method of claim 1, wherein the focal point comprises an associated area around the focal point, and wherein determining that the focal point is within the operational range of the menu navigation comprises determining that the associated area is within the operational range of the menu navigation element.
6. The method of claim 1, wherein the operational range of the menu navigation element comprises an associated area around the menu navigation element, and wherein determining that the focal point is within the operational range of **the** menu navigation comprises determining that the focal point is within the associated area.
7. The method of claim 1, wherein the focal point and the menu navigation element each includes an associated area, and wherein determining **that** the focal point is within the operational range of the menu navigation comprises determining that the associated area of the focal point overlaps the associated area of the menu navigation element.
8. The method of claim 1, wherein executing the fixation timer corresponding to the navigation element comprises determining whether the focal point has moved out of the operational range since the fixation timer began execution.
9. The method of claim 8, wherein executing the fixation timer corresponding to the navigation element further comprises confirming that the focal point remains within the operational range of the menu navigation element.
10. The method of claim 8, wherein executing the fixation timer corresponding to the navigation element further comprises confirming that an area associated with the focal point remains within the operational range of the menu navigation element.

11. The method of claim 8, wherein executing the fixation timer corresponding to the navigation element further comprises confirming that an area associated with the focal point continues to overlap an area associated with the menu navigation element.
12. The method of claim 1, further comprising changing an appearance of the focal point during the execution of the timer.
13. The method of claim 1, further comprising changing an appearance of the navigation element during execution of the timer.
14. The method of claim 1, further comprising changing an appearance of an area associated with the focal point during execution of the timer.
15. The method of claim 1, further comprising changing an appearance of an area associated with the navigation element during execution of the timer.
16. The method of claim 1, further comprising changing an appearance of the focal point and the navigation element during execution of the timer.
17. The method of claim 1, further comprising changing an appearance of the focal point and an area associated with the navigation element during execution of the timer.
18. The method of claim 1, further comprising changing an appearance of an area associated with the focal point and the navigation element during execution of the timer.

19. A non-transitory **computer** readable storage medium having embodied thereon a program, the program being executable by a processor to perform a method for menu navigation in a head-mounted display, the method comprising:

generating positional data of **the** head-mounted display;

displaying a focal point of the head-mounted display within a virtual environment;

tracking a position of the focal point of the head-mounted display, wherein the position of the displayed focal point is moved over one or more visual elements within **the** virtual environment;

determining that the displayed focal point is within an operational range of a menu navigation element in **the** virtual environment;

executing a fixation timer corresponding to the navigation element, wherein the fixation timer counts down a predetermined amount of time when **the** displayed focal point is within the operational range of the menu navigation element, and wherein the fixation timer stops counting when the focal point moves **out of** the operational range; and

implementing a corresponding function of the navigation element upon expiration of the predetermined amount of time as indicated by the fixation timer.

20. A system for menu navigation, the system comprising:

at least one of a gyroscope, magnetometer, and an accelerometer that generate positional data;

a head-mounted display including at least one lens to display a focal point in a virtual environment that includes a menu navigation element;

a processor that executes instructions stored in memory to:

process the positional data to track the position of the focal point within the virtual environment, wherein the position of the displayed focal point is moved over one or more visual elements within the virtual environment,

determine that the displayed focal point is within an operational range of a menu navigation element in the virtual environment,

execute a fixation timer corresponding to the navigation element, wherein the fixation timer counts down a predetermined amount of time when the displayed focal point is within the operational range of the menu navigation element, and wherein the fixation timer stops counting when the focal point moves out of the operational range, and

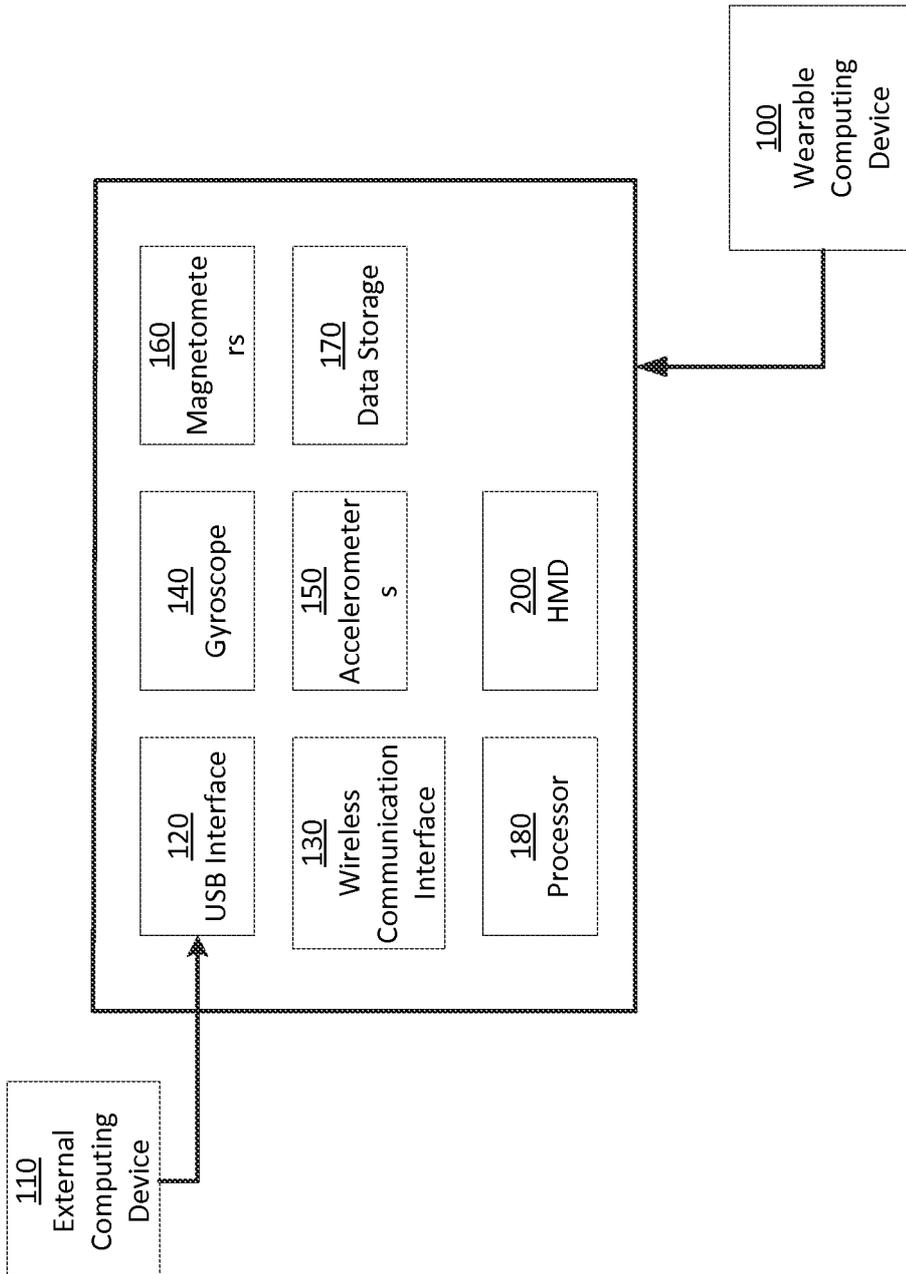
execute a functionality associated with the menu navigation element upon expiration of the predetermined amount of time as indicated by the fixation timer.

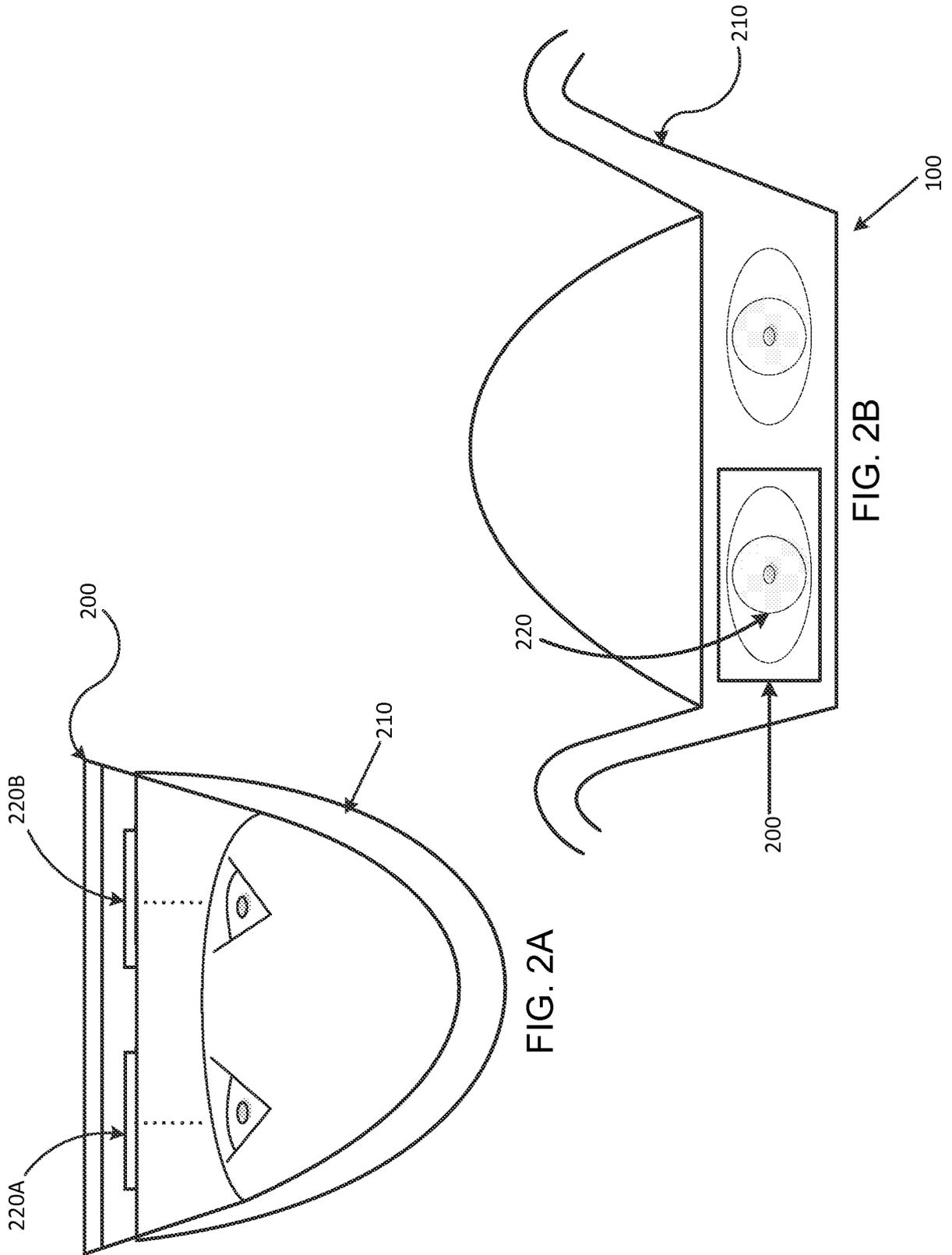
**STATEMENT UNDER ARTICLE 19 (1)**

Dear Sir or Madam:

In response to the *International Search Report and Written Opinion of the International Searching Authority* mailed May 11, 2015, the Applicant submits the following letter **accompanying** the Article 19 Amendments submitted concurrently herewith. A description of and the bases for the amendments begins on page two.

FIG. 1





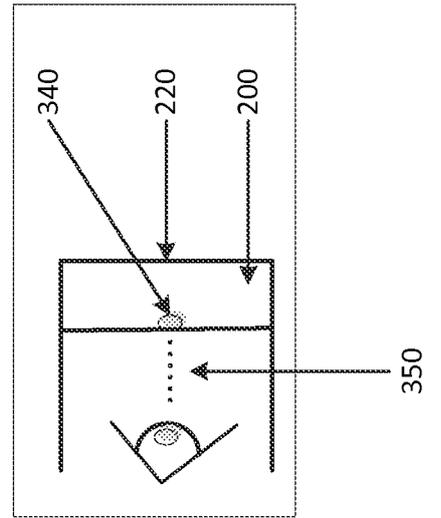
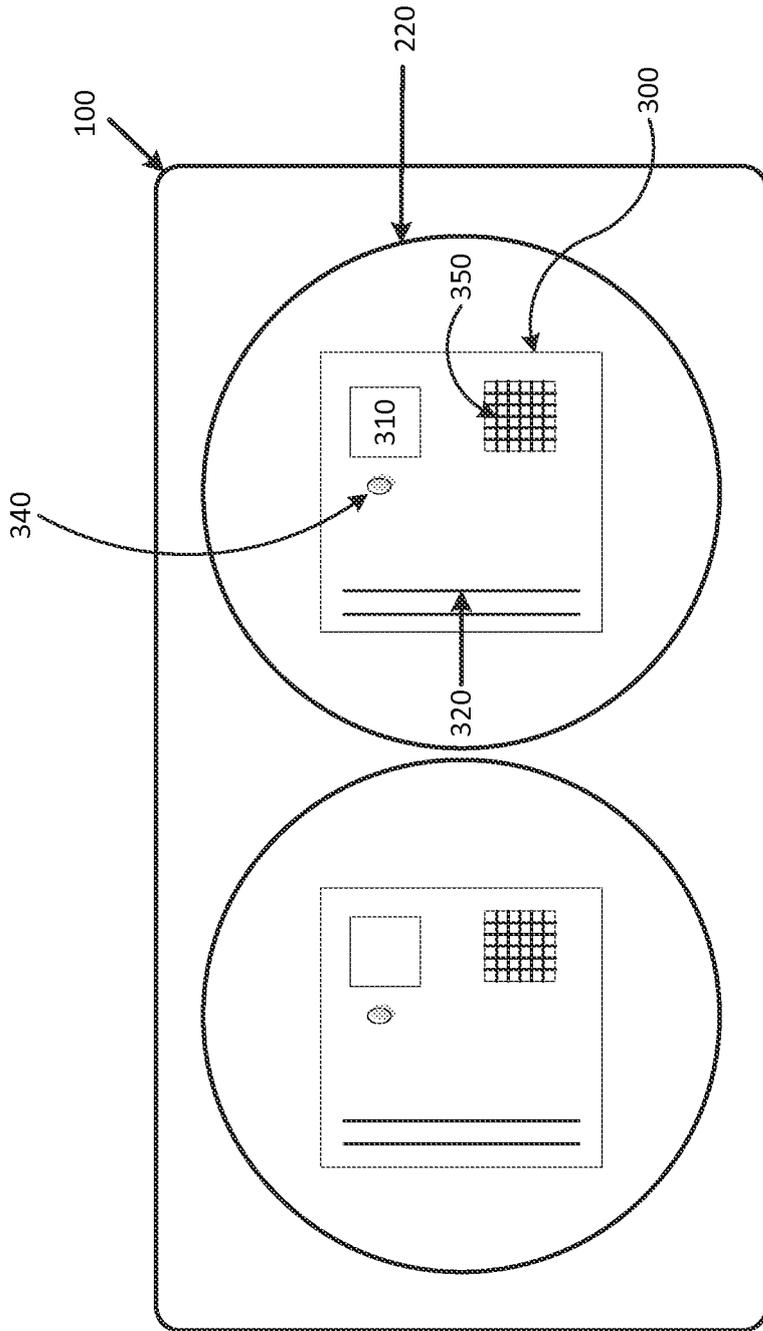


FIG. 3

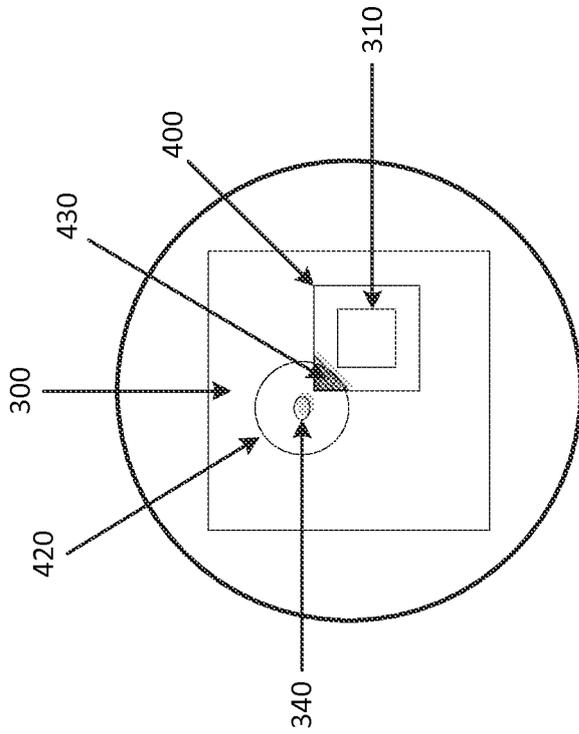


FIG. 4B

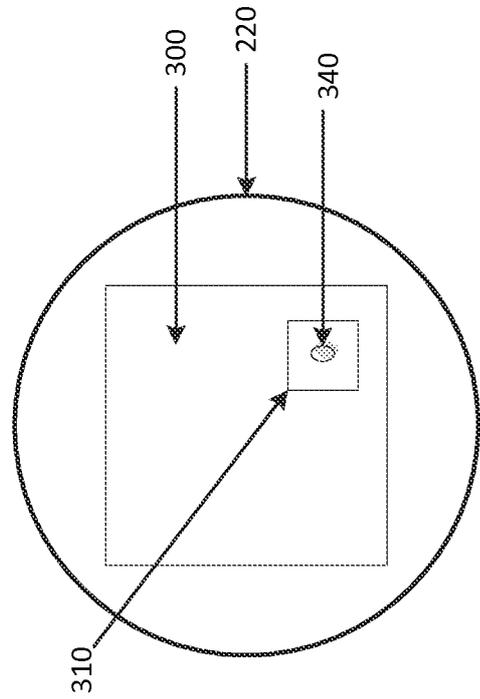


FIG. 4C

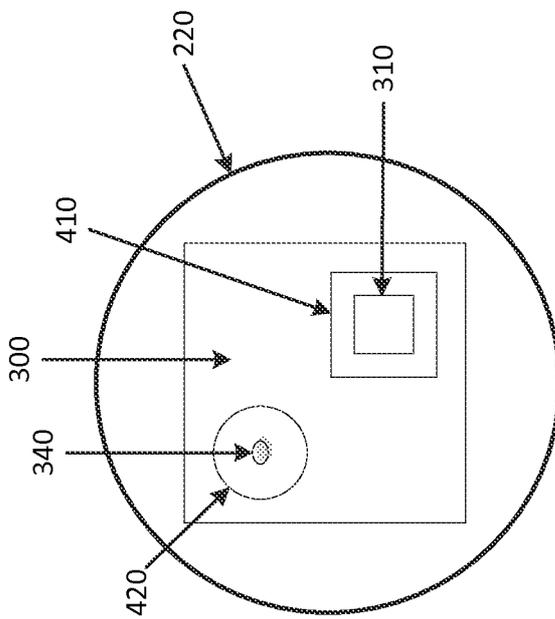


FIG. 4A

**INTERNATIONAL SEARCH REPORT**

**15/010990 11.05.2015**  
International application No.

PCT/US2015/010990

**A. CLASSIFICATION OF SUBJECT MATTER**

IPC(8) - G02B 27/02 (2015.01)  
CPC - G02B 27/017 (2014.12)

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)  
IPC(8) - G02B 27/02, 27/14, G09G 5/00, 5/08, G06T 15/20, H04N 13/00,13/02, 13/04 (2015.01 )  
USPC - 345/8, 158, 419, 633, 348/46, 53, 359/630

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched  
CPC - G02B 23/125, 27/01 , 27/017, 27/0093, 2027/014 (2014.12) (keyword delimited)

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

Orbit, Google Patents, Google Scholar

Search terms used: head-mounted display, menu, navigation menu, focal point, position tracking, gyroscope, accelerometer, magnetometer, timer, eye tracking, gaze tracking, fixation timer

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2012/0154557 A1 (PEREZ et al.) 21 June 2012 (21.06.2012) entire document	1-20
A	US 5,982,555 A (MELVILLE et al.) 09 November 1999 (09.11.1999) entire document	1-20
A	US 2006/0028400 A1 (LAPSTUN et al.) 09 February 2006 (09.02.2006) entire document	1-20
A	US 2012/0154277 A1 (BAR-ZEEV et al.) 21 June 2012 (21.06.2012) entire document	1-20
A	US 2012/0249741 A1 (MACIOCCI et al.) 04 October 2012 (04.10.2012) entire document	1-20
A	US 2013/0021 373 A1 (VAUGHT et al.) 24 January 2013 (24.01.2013) entire document	1-20
A	US 2013/0083009 A1 (GEISNER et al.) 04 April 2013 (04.04.2013) entire document	1-20

Further documents are listed in the continuation of Box C.

* Special categories of cited documents:	"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"A" document defining the general state of the art which is not considered to be of particular relevance	"X" 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
"E" earlier application or patent but published on or after the international filing date	"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"&" document member of the same patent family
"O" document referring to an oral disclosure, use, exhibition or other means	
"P" document published prior to the international filing date but later than the priority date claimed	

Date of the actual completion of the international search 02 April 2015	Date of mailing of the international search report <b>11 MAY 2015</b>
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Name and mailing address of the ISA/US Mail Stop PCT, Attn: ISA/US, Commissioner for Patents P.O. Box 1450, Alexandria, Virginia 22313-1450 Facsimile No. 571-273-3201	Authorized officer: Blaine R. Copenheaver  PCT Helpdesk: 571-272-4300 PCT OSP: 571-272-7774
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