

(21) Application No: 1312646.1
(22) Date of Filing: 15.07.2013

(51) INT CL:
G02B 27/01 (2006.01)

(56) Documents Cited:
GB 2499102 A CN 202931422 U
US 20130141360 A1 US 20100079356 A1

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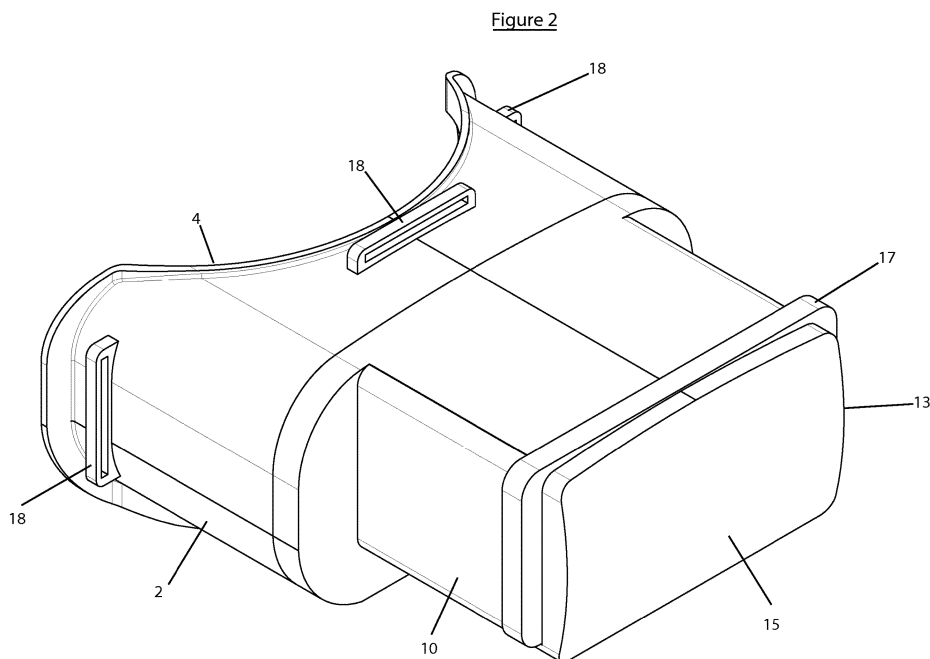
(58) Field of Search:
INT CL G02B
Other: WPI, EPODOC, TXTE

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(54) Title of the Invention: **Head mounted display**
Abstract Title: **Head mounted display**

(57) A head mounted viewing device 1 has a housing, which may be made of two telescoping parts 2, 10, having two open ends with a head interface 4 at one end shaped to fit around the eyes of a wearer, and a device holder 13, to hold a device 17 which could be a smartphone or a portable device with a screen, at the second end. A lens 9 is positioned within a passageway between the two ends, which magnifies a users view of the screen and varies the apparent optical distance to the screen.



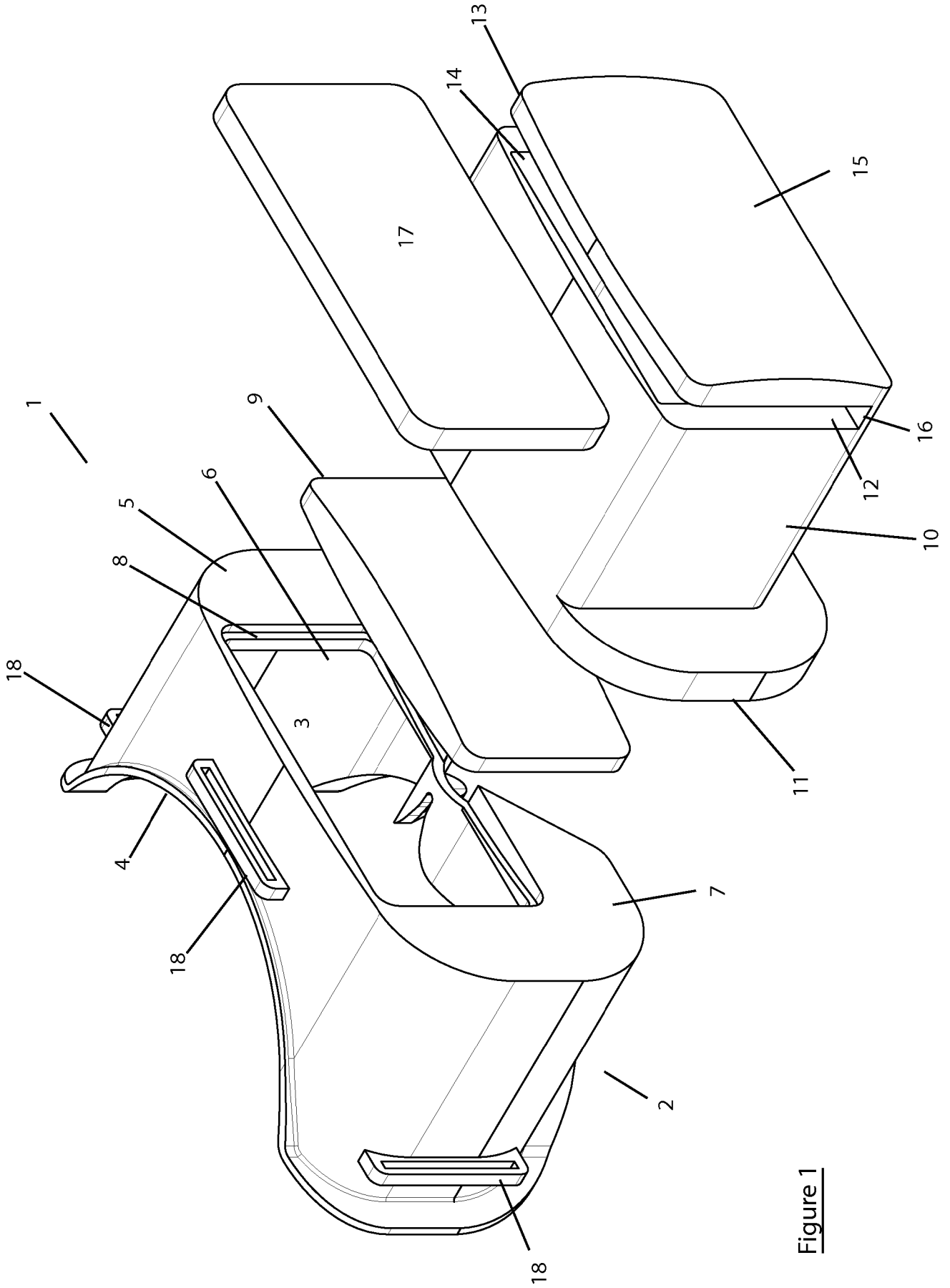


Figure 1

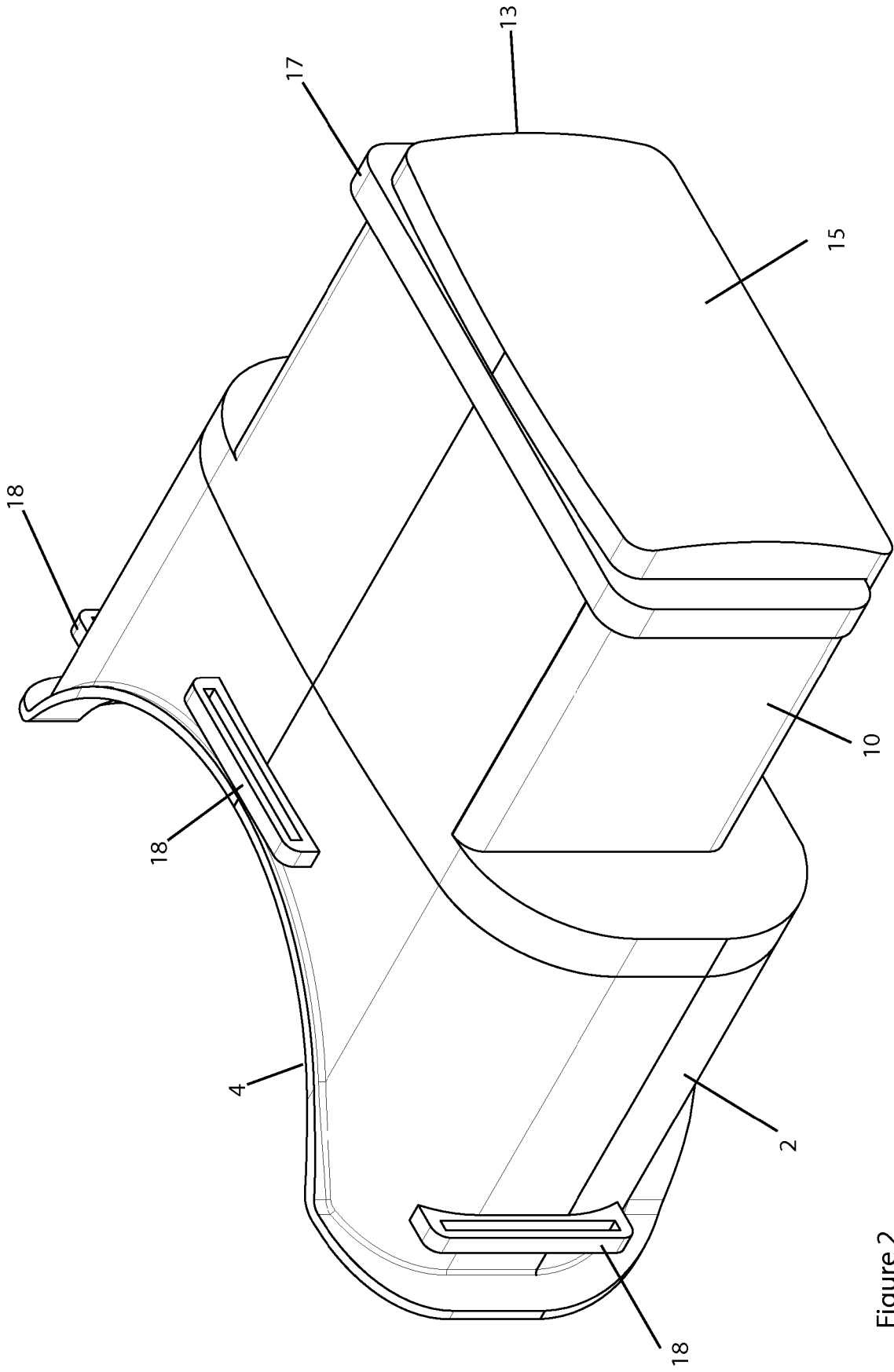


Figure 2

DESCRIPTION

Title: Head mounted display

The invention relates to a device which functions as a head mounted display, particularly for gaming, virtual reality and viewing video images.

It is an object of the invention to provide an improved display of this type.

Accordingly, one aspect of the invention provides a viewing device according to claim 1 of the attached claims.

Preferred features of the device appear in the dependent claims.

In order that the present invention can be more readily understood embodiments thereof will now be described, with reference to the accompanying drawings, in which:

Figure 1 shows an exploded view of components of a device embodying the present invention; and

Figure 2 shows the device of figure 1 when fully assembled.

Turning firstly to figure 1, components of a viewing device 1 are shown in exploded view.

The viewing device 1 includes a first housing member 2, which generally takes the form of a hollow, elongate tube defining an internal passage 3. At a first end of the first housing member 2 defines a head interface 4, which is adapted to fit closely against a wearer's head (not shown). The head interface 4 comprises an edge of the first housing member 2 which is shaped to fit around the wearer's eyes, so that the wearer can see into the internal passage 3 with both eyes.

In preferred embodiments the head interface 4 fits across the wearer's forehead, around the sides of the wearer's eyes, and over the bridge of the wearer's nose, so that the wearer's nose is not within the internal passage 3, in a similar manner to ski goggles or the like. Many other configurations are possible, however.

The proportions and dimensions of wearers' faces can vary significantly, and so a layer of a soft material, such as a compressible foam, may be provided around the head interface. This will assist in forming a comfortable fit, and also reduce

the amount of light that may enter the internal passage 3 through gaps between the wearer's face and the head interface 4.

The second end 5 of the first housing member defines an opening 6. In the embodiment shown the opening 6 is formed in an end wall 7 which includes a peripheral recess 8. A lens 9 is fitted into the recess 8, so that the lens 9 entirely or substantially fills the opening 6. The properties of the lens 9 will be discussed in more detail below.

A second housing member 10 also takes the form of a hollow, elongate tube defining an internal passage, and has an open first end 11 which fits over the open second end 5 of the first housing member 2. When the first and second housing members 2, 10 are fitted together, their internal passages 3 substantially align with one another, so that a wearer of the device 1 can see through the internal passage 3 of the first housing member 2, through the lens 9 and into the internal passage of the second housing member,

The first and second housing members 2, 10 can be joined together in any suitable manner, for instance by gluing or welding, and in some embodiments they may be formed integrally with each other.

The second, distal end 12 of the second housing member 10 comprises a device holder 13. In the embodiment shown, the second housing member 10 defines an opening 14 at its second end 12, with a holding plate 15 being positioned across the opening 14. The holding plate 15 is spaced apart from the opening 14, and is of generally the same size as the opening 14. The holding plate 15 is connected to the main body of the second housing member 10 by a resilient connector 16 that extends across the bottom edge of the second housing member 10 and the holding plate 15. The holding plate 15 may therefore be deflected with respect to the main body of the second housing member 10.

In use, a portable device such as a smartphone 17 may be held and retained between the holding plate 15 and the walls surrounding the opening 14 at the second end 12 of the second housing member 10, with the holding plate 15 exerting a holding force on the smartphone 17 due to the elasticity of the resilient connector 16. The gap between the holding plate 15 and the main body of the second housing member 10 is set to be approximately the same as, or slightly less than, the thickness of a standard smartphone, to allow the smartphone 17 to be gripped and held in place effectively. In use, the smartphone 17 is oriented so that the screen thereof faces inwardly, into the internal passage of the second housing member 10.

The first and second housing members 2, 10 are formed from a material which is substantially opaque to visible light. When the viewing device 1 is fully assembled, as shown in figure 2, the head interface 4 is fitted closely against a wearer's head, and a smartphone 17 is held correctly by the device holder 13, the viewing device 1 forms a passage into which substantially no external ambient light can penetrate, and so substantially the only light seen by the wearer is light from the screen of the smartphone.

A retaining arrangement is preferably provided to hold the viewing device 1 in place so that the user may have both hands free. The retaining arrangement may comprise a plurality of elastic straps (not shown), attached to the device 1 at suitable attachment points 18. In some embodiments one of the straps may extend over the top of the wearer's head, and a counterweight may be provided in the region of the back of the wearer's head. This allows the weight of the device 1 to be balanced, so that the device 1 does not cause an uncomfortable downward dragging effect on the wearer's face.

In the case of the application being run requiring the user to control the device through the touch screen interface, it is convenient that the display allows the wearer's hands to be free in order to operate the device through the use of an external controller such as a mouse/keyboard/game controller or any other suitable external controller connected to the device through a wire or wirelessly.

The viewing device may contain built-in speakers and/or headphones, which may be connected to an audio output of the smartphone 17.

In the embodiment shown the first and second housing members 2, 10 are substantially fixed in place with respect to each other. In other embodiments the first and second housing members 2, 10 may move relative to each other, for instance by being telescopically attached together. This may allow the distance between the wearer's eyes and the lens, and/or between the wearer's eyes and the screen of the smartphone 17, to be varied. It should be understood that the lens may be held within the second housing member 10, instead of by the first housing member 2.

Examples of the devices to be used with the viewing device 1 include but are not limited to smart phones, hand held computers and pads and other palm computers and light weight screens. These devices should be able to run/play video and game applications. Many of these devices have gyroscopic technology and accelerometers built into them, allowing the user to enjoy a variety of games and other applications that use this technology.

The viewing device 1, when combined with an electronic screen device, turns it

into a head mounted screen vision device which takes advantage of, and in many cases enhances, the technology already existent in the fore-mentioned device.

In the case of the gyroscopic and accelerometer technology for example which allows the device to detect the orientation and movement of the device itself, the viewing device 1, because it is attached to the user's head at the level and in line with the eyes, match the viewing field of the wearer to the motion of the device 1 which in turn is matched and controlled by the movement of the wearer's head. The new combined device (viewing device 1 plus screen containing device) allows the wearer to view different parts of a virtual or recorded/photographed environment (such as with 360 degree photo and video) in a similar way as one would view a real place, that is to say, as the wearer moves their head, what the viewer sees will change as it would if one is to turn their head to look to the side or behind them, providing that the file or video one is watching supports and provides such capabilities, and that the device being used supports that technology.

The viewing device 1 can be used for gaming, viewing movies and other video files, as well as any other application the wearer feels the viewing device 1 would enhance.

The viewing device 1 can become a tool to view pre-recorded or live (through streaming) environments captured in 360 degree photo and video cameras in a naturalistic way. Without the viewing device 1 usually these devices would be controlled through the user's hand movements instead of by the user's head.

A wide angled lens may be used to create the illusion of a much bigger screen, and the blocking of the external light enhances the viewing experience by allowing the user to focus and concentrate only on the images provided within the device 1.

The viewing device 1 coordinates through physical attachment of the smartphone etc. to the user's head, the movement of the head to the movement of the smartphone etc., creating a highly seamless and convincing effect

There are head mounted displays in existence already, with and without built-in movement sensors. An important difference between the proposed invention and these other devices is that the previously mentioned existing devices use built-in displays. So they include the screen and in some also the sensor and the sound within the device. Because of the technology included within those head mounted displays there is a much higher cost both in research and development and manufacturing, and these costs are reflected in the retail

price, which is considerably higher than the cost of the viewing devices disclosed herein.

The proposed invention has not got a built-in display, but instead is a system to magnify the screen of a lightweight device incorporating an electronic screen. What we have created is an adaptor with a wide angled lens and correct proportions so that the user can insert an existing device and convert this device into a head mounted display. The lens, combined with the correct proportions of the viewing path, magnifies and focuses the lightweight device's screen.

Another important feature of the proposed invention is that it uses at least one wide angle lens wide enough to allow the user to view the screen through the lens with both eyes. There are not different lenses for each eye, but the eyes both view the screen through the same lens. In some embodiments, more than one lens may be provided within the device. The lenses may be spaced apart from each other, and/or may be abutted or joined together to form a composite lens. However, in these embodiments, the additional lenses are also arranged so that both eyes view the screen through the or each additional lens. The use of additional lenses may improve the optical properties of the device 1, or may allow the user to change the focal length and/or the magnification of the screen.

To add to the above, it is also an important feature that the screen being viewed (i.e. the device screen) is not split or divided and that there is no physical or other kind of restriction built in to the device that restricts one eye or the other from seeing the entire screen. It is essential that both eyes are free to see the entire screen (unless the user has a personal impediment which prevents this from being possible).

The proposed adaptor takes advantage of the fact that a very large amount of people already own the technology and the screen as it is within their smartphone or tablet, so they would just have to purchase the viewing device 1 to enjoy the effects created by head mounted displays. This is opposed to having to buy another high tech piece of equipment that is contained within the goggles and solely usable for that purpose. The adaptor offers a way for people to cheaply convert their mobile device or screen into head mounted display goggles.

The viewing device 1 represents a low cost solution to compete with existing head mounted display goggles that, because they incorporate the technology within their head mounted unit, are much more expensive.

There is a mobile phone adaptor in existence that has a lens for each eye and

has a physical barrier that isolates each eye's field of view from the other as they view the screen. It is marketed as 3D viewing glasses and are used with software particular to this function.

The proposed invention is not an adaptor to convert a device into 3D viewing device. The proposed invention is a 2D optical system, and does not particularly require any special or specific software or split video recording reproduction to fulfill its intended purpose. With this said, however, it has been found that if the viewing device 1 is used with a smartphone or the like with a 3D screen, the 3D effect will not be lost.

A further advantage of the invention is that the device being adapted does not require to be physically modified, taken apart, or require any wiring other than the wiring already intended for the original and intended function of the device (i.e. charger, headphones etc.).

No physical modifications are required to operate the device. But its use can be enhanced by connecting the device to a joystick or other operation controlling devices/tools, as briefly mentioned above.

A smartphone etc. used with the viewing device 1 can be removed easily and with no requirement of any tools other than those integrated into the system used to attach the device onto the adaptor.

The purpose of the lens 9 is to magnify and focus the screen to increase the apparent size of the screen from the user's perspective. The lens may also, or alternatively, increase the effective optical distance between the wearer's eyes and the screen, so that the screen is at a more comfortable viewing distance.

The lens 9 may, for example, be a 1.5x magnifying lens. For a 4 inch screen, for example, the preferred degree of magnification would be 0.5x-3x, depending on the distances between the lens and the screen and the eyes and the lens.

The lens 9 may, for example, increase the effective optical distance from the wearer's eyes to the screen. For a 4 inch screen, for example, a range for a comfortable viewing distance would be between 0-12cm from the lens to the screen. This would be dependent on the qualities of the lens or lenses being used, or the effect of combined lenses being used when lined up in front of one another to shorten the actual distance while increasing the effective optical distance.

For a 4 inch screen the distance between the eye and the lens should be between 1.5-8cm, depending on the characteristics of the lens or combination

of lenses being used.

The lens 9 may be a Fresnel lens, and the skilled reader will understand that this may reduce the width and weight of the lens.

The adaptor is a mono and not a stereo optical system, in that both eyes see through the same lens or set of lenses and each eye does not have a separate lens from the other eye.

The adaptor contains a wide angled magnifying lens of certain specification depending on the screen qualities and dimensions of the portable device being used, and wide enough to allow both of the user's eyes to view through the same lens. This lens is located in front of the wearer's eyes and in line with the screen of the adapted device.

The adaptor does not require the device being used to run customized or dedicated applications in order to function as required. (i.e. if a video is played in the device, the film will be able to be seen through the goggles directly, without the need for any further software)

The adaptor's preferred embodiment is of goggles in the style of ski goggles in the way that they connect to the wearer's face and in the way in which they hold the lens, with an extended front portion comprising a pathway channeling the wearer's view and at its furthest point from the face, a place where the portable device is mounted.

The goggles hold a wide angled magnifying lens (of certain specification depending on the portable device being adapted and wide enough to allow both of the user's eyes to view through the same lens) in front of the wearer's eyes.

This lens then leads on the other side to an elongated hollow structure in which one end frames the display of the device being adapted and at the other end it frames the lens.

The shape of the elongated chamber and the distances depend and vary according to the screen size of the portable device being adapted and the lens needed to bring it into focus.

The above mentioned elongated structure is preferably opaque as to restrict external light from coming into the viewing field of the user and in that way to enhance the perception of the screen projection. At the far end of this tunnel there is a part that fits the mobile device so that its screen points inwards

towards the lens and then the wearer's eyes, with minimal interference from external light.

The main body of the goggles are planned to be made principally of plastic but it would be possible to use other light weight materials including carbon fibre and aluminum.

One embodiment of the invention has a system of straps to hold the goggles onto the wearer's head. The goggles would fit onto the face in a way comparable to skiing goggles, with one strap going from one side of the face to the other passing across the temple area, around the back of the head and then passing the other temple area and then attaching to the goggles. The other strap would attach to the top of the goggles around the forehead area and running along the top of the wearer's head and then attaching to the other strap mentioned before, at the point where the first strap is going around the back of the wearer's head. This would provide a close fit and also some support for the weight of the device through the top strap.

The goggles may be held to the head by two sets of straps one from one side of face to the other, the second from the top of goggles to the back of the first-mentioned straps

In one embodiment of the device the straps would be adjustable. The straps may also include a counterweight to balance the weight of the device on the wearer's head

The field of view the wearer will experience will depend on the size of the display of the portable device being adapted and the related magnifying lens

One preferred embodiment of the device holder (to clip/attach/slide the device onto the adaptor) will leave an opening to connect the user's own earphones to the device while it is attached to the adaptor.

One preferred embodiment of the device holder (to clip/attach/slide the device onto the adaptor) will leave an opening to connect the device's power supply to the device while it is attached to the adaptor.

Preferably the mobile device can be quickly removed from device (ie to answer a phone call or to pause a game/video being viewed).

Some embodiments of the invention comprise a built-in electronic screen at the second end of the second housing member. These embodiments comprise an integral viewing device, rather than a device which is adapted to hold and retain

an existing portable device having a screen. These embodiments may include motion and/or orientation sensors, and also other elements such as a power source. In these embodiments the screen is, as above, seen through one or more lenses with both eyes, and lenses are not provided through which a user may view the screen with one eye but not the other.

The preferred shape of the lens is substantially rectangular. This is because, at the present time, most portable devices suitable for use with the viewing device have a screen that is rectangular. Matching the shape of the lens to the shape of the screen of the portable device means that the screen can be of minimum size. For corresponding reasons, the cross-sectional shape of the passage formed by the first and second housing members is also preferably substantially rectangular. Any other suitable shape for the lens may be used, however.

The types of lenses that could be used are, for example convex-convex, planar-convex, convex-concave, planar-concave, or Fresnel. These lenses can be used in combination or alone, depending on the effect required. This effect could be changes in the distance between the eyes and the lens and the lens and the screen, and depending on the size of the screen in question and the required magnification or in some cases reduction of its effective optical distance

Any lens that reduces the focusing distance between the viewer's eyes and the screen can be used

In the case of a small screen being used the lens would be required to enlarge and focus the screen. In the case of a relatively larger screen it may be preferable to have a lens which does not magnify the screen but instead just brings it into focus, as the screen would be large enough to achieve the desired effect at a particular distance without the use of magnification or reduction.

Claims

1. A viewing device comprising:

a housing having an open first end and an open second end and defining a passage between the first and second ends which is substantially opaque to visible light;

a head interface provided at the first end of the housing, the head interface being shaped to fit around at least the eyes of a wearer such that substantially no light can pass between the wearer's head and the interior of the passageway, and so that the wearer's eyes are surrounded by the head interface and the wearer can see into the interior of the passageway;

a device holder provided at the second end of the passageway, adapted to hold and retain a portable device having a screen so that the screen of the device is held against the second end of the passageway;

a head attachment arrangement to attach the viewing device to the head of the wearer, so that the viewing device remains in place whilst leaving the wearer's hands free; and

a lens positioned within the passageway between the first and second ends thereof, so that when the viewing device is worn by a wearer and a portable device having a screen is held by the device holder, the lens magnifies the wearer's view of the screen and/or varies the apparent optical distance between from the wearer's eyes to the screen, wherein the lens substantially fills the passageway and both of the wearer's eyes view the screen through the lens.

2. A viewing device according to claim 1, wherein the housing is formed from at least two parts which are movable relative to each other,

so that the distance between the first and second ends of the housing can be reduced or increased.

3. A viewing device according to claim 2 wherein the housing comprises first and second parts which can move telescopically with respect to each other.
4. A viewing device according to claim 3, wherein the first part includes, or is attached to, the head interface, and the second part includes, or is attached to, the device holder, and wherein the lens is substantially fixed in place with respect to the first part or the second part.
5. A viewing device according to any preceding claim wherein the head interface comprises an edge which, in use, rests against the user's head or face, and wherein a layer of a compressible material is provided over at least some of the edge.
6. A viewing device according to any preceding claim wherein the device holder comprises two grip elements which are biased towards one another so that the portable device can be gripped between the two grip elements.
7. A viewing device according to claim 6 wherein one of the grip elements comprises a part of the housing at or near the second end thereof.
8. A viewing device according to claim 7 wherein the one of the grip

elements comprises a region surrounding the open second end of the housing.

9. A viewing device according to claim 7 or 8, wherein the other of the grip elements comprises a member which at least partially covers the open second end of the housing and, if deflected away from the second end of the housing, is biased towards the second end of the housing.

10. A viewing device according to one of claims 6 to 9 wherein the first and second grip elements are connected by a resilient deformable member which may deform to allow the grip elements to be separated from each other.

11. A viewing device according to any preceding claim wherein the head attachment arrangement comprises one or more retaining elements which, in use, may pass around the wearer's head.

12. A viewing device according to claim 11, wherein the head attachment arrangement comprises a retaining element in the form of a flexible strap which, in use, passes around the sides of the wearer's head.

13. A viewing device according to claim 11 or 12 wherein the head attachment arrangement comprises a retaining element which, in use, passes over the top of the wearer's head.

14. A viewing device according to claim 13, further comprising a counter-weight attached to the retaining element so that, in use, the counter-weight is located at or near the rear of the wearer's head, to

counterbalance at least partially the weight of the viewing device.

15. A viewing device according to any preceding claim, wherein the lens is a single, unitary lens.

16. A viewing device according to any preceding claim wherein there is no lens provided in the passageway that, in use, allows the wearer to view the screen of a portable device, held by the device holder so that the screen fills the open second end of the passageway, through one eye but not the other eye.

17. A viewing device according to any preceding claim wherein two or more lenses are provided, each of the lenses being positioned within the passageway between the first and second ends thereof, so that when the viewing device is worn by a wearer and a portable device having a screen is held by the device holder, the lens substantially fills the passageway and both of the wearer's eyes view the screen through the lens.

18. A viewing device according to any preceding claim wherein the device holder is adapted to hold a substantially planar portable device, having an area sufficient to cover the open second end of the housing, against the open second end of the housing so that substantially no light can enter the passageway around the sides of the device.

19. A viewing device comprising:

a housing having an open first end and a second end and defining a passage between the first and second ends which is substantially opaque to visible light;

a head interface provided at the first end of the housing, the head interface being shaped to fit around at least the eyes of a wearer such that substantially no light can pass between the wearer's head and the interior of the passageway, and so that the wearer's eyes are surrounded by the head interface and the wearer can see into the interior of the passageway;

a display screen provided at the second end of the passageway, so that the display of the screen is directed into the passageway towards the first end thereof;

a head attachment arrangement to attach the viewing device to the head of the wearer, so that the viewing device remains in place whilst leaving the wearer's hands free; and

a lens positioned within the passageway between the first and second ends thereof, so that when the viewing device is worn by a wearer the lens magnifies the wearer's view of the screen and/or varies the apparent optical distance between from the wearer's eyes to the screen, wherein the lens substantially fills the passageway and both of the wearer's eyes view the screen through the lens.

20. A viewing device according to any preceding claim, wherein the lens increases the apparent optical distance between from the wearer's eyes to the screen.

21. A viewing device according to one of claims 1 to 19, wherein the lens decreases the apparent optical distance between from the wearer's eyes to the screen.

22. A viewing device substantially as hereinbefore described, with

reference to the accompanying drawings.



Application No: GB1312646.1

Examiner: Mr Joseph Mitchell

Claims searched: 1-18, 20 & 21

Date of search: 17 January 2014

Patents Act 1977: Search Report under Section 17

Documents considered to be relevant:

| Category | Relevant to claims | Identity of document and passage or figure of particular relevance |
|----------|-------------------------------|---|
| X | 1, 5, 6, 11-13, 15-18, 20, 21 | GB 2499102 A (PATEL) Whole document relevant |
| X | 1, 5-7, 15-18, 20, 21 | US 2010/079356 A1 (HOELLWARTH) See paragraphs 0071, 0072, 0134-0138, 0146 & 0147 in particular. |
| A | - | US 2013/141360 A1 (COMPTON) |
| A | - | CN 202931422 U (WANG) |

Categories:

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| X | Document indicating lack of novelty or inventive step | A | Document indicating technological background and/or state of the art. |
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Field of Search:

Search of GB, EP, WO & US patent documents classified in the following areas of the UKC^X :

Worldwide search of patent documents classified in the following areas of the IPC

G02B

The following online and other databases have been used in the preparation of this search report

WPI, EPODOC, TXTE

International Classification:

| Subclass | Subgroup | Valid From |
|----------|----------|------------|
| G02B | 0027/01 | 01/01/2006 |