United States Patent 12386451
Kind Code B2
Date of Patent August 12, 2025
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Touch sensitive input surface

Abstract

In at least one example of the present disclosure, a head-mountable device includes a display, a frame at least partially surrounding the display, a facial interface attached to the frame, a cover disposed around the facial interface, and a touch sensitive surface incorporated into the cover to receive input from a user for the head-mountable device.

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Appl. No.: **18/450386**

Filed: **August 15, 2023**

Prior Publication Data

Document Identifier	Publication Date
US 20240094840 A1	Mar. 21, 2024

Related U.S. Application Data

us-provisional-application US 63375919 20220916

Publication Classification

Int. Cl.: **G06F3/041** (20060101); **G06F3/01** (20060101); **G06F3/0346** (20130101)

U.S. Cl.:

CPC **G06F3/0414** (20130101); **G06F3/016** (20130101); **G06F3/0346** (20130101); G06F2203/04102 (20130101)

Field of Classification Search

CPC: G06F (3/0414); G06F (3/016); G06F (3/0346)

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Background/Summary

CROSS-REFERENCE TO RELATED APPLICATION(S) (1) This claims priority to U.S. Provisional Patent Application No. 63/375,919, filed 16 Sep. 2022, and entitled “Touch Sensitive Input Surface,” the entire disclosure of which is hereby incorporated by reference.

FIELD
(1) The described examples relate generally to head-mountable devices. More particularly, the present disclosure relates to light seals for head-mountable devices that include touch sensitive input surfaces.
BACKGROUND
(2) Recent advances in portable computing have enabled head-mountable devices that provide augmented and virtual reality (AR/VR) experiences to users. Such head-mountable devices typically include various components such as a display, a viewing frame or housing, a lens, a battery, a motor, speakers, and other components. These components can operate together to provide an immersive user experience. Additionally, head-mountable-devices can include components that help provide a distraction-free setting by blocking or sealing off the outside environment (e.g., ambient light). One way this can be accomplished is through the use of a light seal that defines an enclosed “eye-box” between the display and the user's eyes.
(3) Due to the immersive environment created by head-mountable devices, consumers are always seeking input devices with increased and improved functionality. However, the desire for increased functionality is often offset by a desire not to increase the size or weight of the head-mountable device.
SUMMARY
(4) In at least one example of the present disclosure, a head-mountable device includes a display, a frame at least partially surrounding the display, a facial interface attached to the frame, a cover disposed around the facial interface, and a touch sensitive surface incorporated into the cover to

receive input from a user for the head-mountable device.
(5) In one example, the head-mountable device further includes a first distinct touch sensitive surface and a second distinct touch sensitive surface disposed on an outer surface of the cover. In one example, the head-mountable device further includes a strain gauge disposed in the frame and electrically connected to the touch sensitive surface. In one example, the touch sensitive surface of the head-mountable device includes a conductive fabric. In one example, the touch sensitive surface of the head-mountable device is disposed on an outer surface of the cover and includes a distinct perimeter and the head-mountable device includes an indicator to direct the user to the touch sensitive surface. In one example, wherein the indicator of the head-mountable device includes a projection that extends outward from the cover along a perimeter of the touch sensitive surface. In one example, the indicator of the head-mountable device includes a visual cue generated on the display. In one example, wherein the indicator includes a light emitting diode positioned on an inner surface of the cover to guide the user to the touch sensitive surface. **9**. In one example, the indicator of the head-mountable device includes a haptic engine disposed in the cover to provide haptic feedback to the user to guide the user to the touch sensitive surface. In one example, the head-mountable device further includes a position sensor configured to detect a near touch of the touch sensitive surface and a processor disposed on the frame, the processor is configured to turn on the touch sensitive surface when the sensor detects the near touch. In one example, the position sensor of the head-mountable device includes a camera.
(6) In at least one example of the present disclosure, a wearable electronic device, includes a display, a frame, a light blocking material attached to the frame, and an input sensor configured to detect an input on the light blocking material.
(7) In one example, the input sensor of the wearable electronic device includes an accelerometer disposed within the frame. In one example, the input sensor of the wearable electronic device includes a first capacitance sensor disposed within the light blocking material and a second capacitance sensor disposed within the light blocking material adjacent to the first capacitance sensor. In one example, the input sensor of the wearable electronic device includes a strain gauge connected to fabric in the light blocking material. In one example, the input sensor of the wearable electronic device comprises a strain gauge disposed with in the frame to detect a deflection of the frame. In one example, the input sensor of the wearable electronic device includes a conductive fabric in a matrix shaped pattern.
(8) In at least one example of the present disclosure, a cover that is removably attachable to a head-mountable display includes a body including an inner surface and an outer surface, a removable fastener attached to the body, and a touch sensitive surface disposed on the outer surface of the cover.
(9) In one example, the touch sensitive surface of the cover includes a conductive fabric that forms a strain gauge. In one example, the inner surface of the cover comprises a first light emitting diode and a second light emitting diode that are positioned are to guide a user to the touch sensitive surface.

Description

BRIEF DESCRIPTION OF THE DRAWINGS
(1) The disclosure will be readily understood by the following detailed description in conjunction with the accompanying drawings, wherein like reference numerals designate like structural elements, and in which:
(2) FIG. **1**A shows a schematic block diagram of a head-mountable device, in accordance with some embodiments.
(3) FIG. **1**B shows a top view of a head-mountable device, in accordance with some embodiments.

(4) FIG. **2** shows a bottom perspective view of a light seal, in accordance with some embodiments.
(5) FIG. **3**A shows a top view of a head-mountable device with conducive fabric in a light seal of the head-mountable device, in accordance with some embodiments.
(6) FIG. **3**B shows a top view of a head-mountable device with a user engaging with a touch sensitive surface of a light seal of the head-mountable device, in accordance with some embodiments.
(7) FIG. **4** shows a touch sensitive surface of a light seal of a head-mountable device, in accordance with some embodiments.
(8) FIG. **5** shows a touch sensitive surface of a light seal of a head-mountable device, in accordance with some embodiments.
(9) FIG. **6** shows a touch sensitive surface of a light seal of a head-mountable device, in accordance with some embodiments.
(10) FIG. **7** shows a head-mountable device with a sensor incorporated with a frame of the head-mountable device, in accordance with some embodiments.
(11) FIG. **8**A shows a head-mountable device with a sensor incorporated with a frame of the head-mountable device, in accordance with some embodiments.
(12) FIG. **8**B shows the head-mountable device of FIG. **8**A with a user mechanically deflecting the frame of the head-mountable device.

DETAILED DESCRIPTION

(13) Detailed reference will now be made to representative embodiments illustrated in the accompanying drawings. The following descriptions are not intended to limit the embodiments to one preferred embodiment. To the contrary, it is intended to cover alternatives, modifications, and equivalents as can be included within the spirit and scope of the described embodiments as defined by the appended claims.
(14) The following disclosure relates to a head-mountable device. More particularly, the present embodiments relate to a light seal of a head-mountable device including manual touch sensitive input surfaces for a user donning the head-mountable device to provide commands to the head-mountable device. As used herein “conductive fabric” can refer to the material or fabric into/onto which conductive elements are incorporated, or can refer to the conductive elements themselves, separate from the material or fabric with which they are integrated. The conductive fabric can include a plurality of conductive fibers. The conductive fabric can act as sensors, input members, and electrical interconnects to enable sensors and other electronic components to interact with one another. A manual input sensor can be a physically activated input system that can be used to provide an indication to a processor of a user's intent.
(15) The head-mountable device of the present disclosure includes a manual input sensor that utilizes a touch sensitive surface that receives user input, such as touch input. The touch sensitive surface can accomplish this while being unobtrusively integrated with the light seal. A head-mountable device with such touch sensitive surfaces adds another way for a user to provide input or commands to a head-mountable device and adding functionality without adding burdensome components or structures.
(16) These and other embodiments are discussed below with reference to FIGS. **1**A-**8**B. However, those skilled in the art will readily appreciate that the detailed description given herein with respect to these Figures is for explanatory purposes only and should not be construed as limiting. Furthermore, as used herein, a system, a method, an article, a component, a feature, or a sub-feature including at least one of a first option, a second option, or a third option should be understood as referring to a system, a method, an article, a component, a feature, or a sub-feature that can include one of each listed option (e.g., only one of the first option, only one of the second option, or only one of the third option), multiple of a single listed option (e.g., two or more of the first option), two options simultaneously (e.g., one of the first option and one of the second option), or combination thereof (e.g., two of the first option and one of the second option).

(17) FIG. **1**A illustrates a block diagram of a head-mountable device ("HMD") **100** including a frame **104**, a display **105**, a support (e.g., retention band **109**), and a light seal or cover **112**. The display **105** can include one or more optical lenses or display screens in front of the eyes of a user. The display **105** can include a display for presenting an augmented reality visualization, a virtual reality visualization, or other suitable visualization. Additionally, the frame **104** can at least partially surround the display **105**. Similarly, the light seal **112** can be connected to the frame **104**. In some examples, the light seal **112** includes the frame **104** (i.e., the frame **104** is part of the light seal **112**).
(18) The light seal **112** can include electrical components (e.g., sensors **120**), a cover **113**, a facial interface **108**, and conductive fabric **116**. The frame **104** can be a housing of the display **105**. Further, the frame **104** can also be considered to be a part of or separate from the light seal **112**. As used herein, the term "light seal" can refer to a portion of the HMD **100** that engages or shields a user's face. In particular, the light seal **112** includes portions (e.g., the facial interface) that conform to, contact, or press against regions of the user's face.
(19) The light seal **112** includes a body with an inner surface and an outer surface. The outer surface is exposed to the external environment and the inner surface is disposed within the space formed by the HMD **100** and the user's face. The light seal can include a pliant (or semi-pliant) facetrack or face engagement component that spans the forehead, wraps around the eyes, contacts other regions of the face (e.g., zygoma and maxilla regions), and bridges the nose. In addition, the light seal **112** can include various components forming a frame, structure, or webbing of a head-mountable device disposed between the display **105** and the user's skin, such as the cover **113**. The cover **113** can include a seal, environment seal, dust seal, air seal, etc. that is positioned between the gap between the display **105** and the user's face. The cover **113** can be a woven fabric that is non-rigid or deformable. The cover **113** can be elastically deformable. In some examples, the cover **113** can be a plastic, rubber, or polymer material. In some examples, the cover **113** can be rigid.
(20) The cover **113** can form an eye-box through which the user can view the display **105**. It will be appreciated that the term "seal" can include partial seals or inhibitors, in addition to complete seals (e.g., a partial light seal where come ambient light is blocked and a complete light seal where all ambient light is blocked when the HMD **100** is donned).
(21) The light seal **112** can have a removable fastener that enables the light seal to be removably attachable to the frame **104** and in electrical communication with the display **105**. The light seal **112** can include an electrical component, such as a sensor **120**. The sensor **120** can collect user or environmental data, such as biometric information. The sensor **120** may receive input from the user, such as the user physically touching the sensor to input or command to the HMD **100** as an indication of the user's intent. The sensor **120** can transmit signals to the HMD, and more particularly to the display **105**. The sensor **120** can transmit signals to an output configured to perform an action in response to the information collected by the sensor **120**.
(22) The light seal **112** can include conductive fabric **116**. In some examples, the conductive fabric **116** can include highly elastic copper threads that can compress and stretch while still maintaining electrical connectivity. The conductive fabric **116** can be elastically deformable (i.e., capable of temporary change in length, volume, or shape). In some examples, the conductive fabric **116** can include electrically conductive carbon fibers. In some examples, the conductive fabric **116** can collect input from the user by the user engaging the conductive fabric through touch, such as with a finger or fingers. These movements can cause a change in the conductive fabric **116** (i.e., stretching or compressing). The degree or amount to which the conductive fabric **116** is moved by the user's finger can be detectable by the conductive fabric **116** and can be used to generate signals that can be analyzed by a processor of the HMD **100**. As described in greater detail below, the conductive fabric **116** can be a thread, line, wire, plate, or any other structure that is capable of conducting electricity. The conductive fabric **116** can be integrated with the light seal **112**. For example, the conductive fabric **116** can be embedded, interwoven, or encapsulated with the cover **113** or facial

interface **108**.

(23) The display **105**, being in electrical communication with the light seal **112**, and more specifically with the conductive fabric **116**, can receive electrical communication and provide feedback to the user related to the readings of the conductive fabric **116** (e.g. visual feedback, audio feedback, haptic feedback, etc.).

(24) As used herein, the term “sensor” refers to one or more different sensing devices, such as a camera or imaging device, strain gauge, capacitance sensors, proximity sensors, touch sensitive sensors, accelerometers, and the like. Additional sensors can include a temperature sensor, oxygen sensor, movement sensor, brain activity sensor, sweat gland activity sensor, breathing activity sensor, muscle contraction sensor, etc. In some examples, the sensor can sense biometric features including features of the autonomic nervous system. Some examples of sensors include an electrooculography sensor, electrocardiogram sensor, EKG sensor, hear rate variability sensor, blood volume pulse sensor, SpO2 sensor, compact pressure sensor, electromyography sensor, core-body temperature sensor, galvanic skin sensor, accelerometer, gyroscope, magnetometer, inclinometer, barometer, infrared sensor, global positioning system sensor, etc. Additional sensor examples can include, contact microphones (e.g., press-based MEMS), bioelectrical activity sensors, UV exposure sensors, or particle sensors.

(25) Any of the features, components, and/or parts, including the arrangements and configurations thereof shown in FIG. **1**A can be included, either alone or in any combination, in any of the other examples of devices, features, components, and parts shown in the other figures described herein. Likewise, any of the features, components, and/or parts, including the arrangements and configurations thereof shown and described with reference to the other figures can be included, either alone or in any combination, in the example of the devices, features, components, and parts shown in FIG. **1**A.

(26) FIG. **1**B shows a top partial view of an HMD **100**. The HMD **100** of FIG. **1**B can be substantially similar to, including some or all of the features of, the HMD **100** described in FIG. **1**A. The HMD **100** can include a display (also referred to as a display unit) **105**. The display **105** can include any number of internal electronic components **107**. The HMD **100** can include a frame **104** (which can also be referred to as a housing) attached to the display **105**. In some examples, the display **105** includes an opaque, translucent, transparent, or semi-transparent screen, including any number lenses, for presenting visual data. The frame **104** can at least partially border one or more edges of the display **105**. The frame **104** can be attached to a cover **113** at one end of the cover **113**. At an opposite end, the cover **113** can form, or be attached to, a facial interface **108**. In some examples, the frame **104**, cover **113**, and facial interface **108** can together form the light seal **112**. It will be understood, however, that the light seal **112** can include fewer or more components that those listed or shown.

(27) The HMD **100** can be worn on a user's head **20** such that the display **105** is positioned over the user's face and disposed over one or both of the user's eyes. The HMD **100** can further include a retention band **109**. The retention band **109** can secure the HMD **100** to the user's head during use so that they user can enjoy the experience provided by the HMD **100**. The display **105** can be connected to the retention band **109** and/or the light seal **112**. In some examples, the retention band **109** can be positioned against the side of a user's head **20** and in contact therewith. In some examples, the retention band **109** can be at least partially positioned above the user's ear or ears. In some examples, the retention band **109** can be positioned adjacent to the user's ear or ears. The retention band **109** can extend around the user's head **20**. In this way, the display **105** and the retention band **109** can form a loop that can retain the HMD **100** on the user's head **20**. It should be understood, however, that this configuration is just one example of how the components of the HMD **100** can be arranged, and that in some examples, a different number of connector straps and/or retention bands can be included. Although the HMD **100** is referred to as an HMD, it should be understood that the terms wearable device, wearable electronic device, head-mountable device,

HMD, HMD device, and/or HMD system can be used to refer to any wearable device, including smart glasses.
(28) In some examples, the frame **104** is attached to a facial interface **108**. The facial interface **108** can contact a user's head **20** and/or face. In some examples, the cover **113** can be a light blocking component that extends between the frame **104** and the facial interface **108**. The light blocking component can cover or surround a perimeter of the frame **104** and/or the facial interface **108**.
(29) The cover **113** can be a cloth, fabric, woven material, plastic, rubber, or any other suitable opaque or semi-opaque material. In some examples, the cover **113** is flexible, having the ability to repeatedly stretch, compress, and deform. The cover **113** can be elastically or in-elastically deformable. The facial interface **108** in combination with the cover **113** can block outside light and limits the peripheral view of the user. In some examples, the cover **113** and the facial interface **108** is the same or a unitary component. As will be discussed in greater detail below, the light seal **112** can include the conductive fabric **116** that is able to serve multiple functions and provide added benefits and functionality to the HMD **100**.
(30) Any of the features, components, and/or parts, including the arrangements and configurations thereof shown in FIG. **1**B can be included, either alone or in any combination, in any of the other examples of devices, features, components, and parts shown in the other figures described herein. Likewise, any of the features, components, and/or parts, including the arrangements and configurations thereof shown and described with reference to the other figures can be included, either alone or in any combination, in the example of the devices, features, components, and parts shown in FIG. **1**B.
(31) FIG. **2** shows a bottom perspective view of select components of a light seal (e.g., **112**). The light seal **112** can be substantially similar to, including some or all of the features of, the light seals described herein, such as light seal **112**. The light seal **112** can be implemented on an HMD, such as HMD **100**.
(32) The light seal **112** can be integrated with conductive fabrics **216***a*, **216***b* (collectively referred to as conductive fabric **216**). The conductive fabric **216** or thread can be positioned at various locations on the light seal **112**. For example, the conductive fabric **216** can be positioned on or in the cover **213** (e.g., embedded, encapsulated, or interwoven into the cover).
(33) In some examples, the conductive fabric **216** can be positioned on the facial interface **108** of the light seal (e.g., light seal **112**). In one example, the conductive fabric **216** can be in direct contact with a user, for example, touching a user's forehead, cheek, nose, temple region, back of the head, or at any location where the HMD contacts the user. In some examples, the conductive fabrics **216** is disposed on an outer surface of the light seal **112**.
(34) In the illustrated example of FIG. **2**, conductive fabrics **216***a* are disposed on a left side of the light seal and conductive fabrics **216***b* are disposed on a right side of the light seal **212**. The conductive fabrics **216***a* can be disposed in a specific touch sensitive surface **218***a* and conductive fabrics **216***b* can be disposed in a touch sensitive surface **218***b*. The touch sensitive surfaces **218***a*, **218***b* can be manual input sensors to receive input from the user by manually or physically touching the touch sensitive surfaces **218***a*, **218***b* to provide input and/or commands to the HMD **100**. However, the conductive fabric **216** can be located in a variety of different locations of the light seal **212**.
(35) FIG. **3**A shows a top view of a head-mountable device (“HMD”) **300**. The HMD **300** can be substantially similar to, including some or all of the features of, the devices described herein, such as HMD **100** and light seal **212**. In some examples, the HMD **300** can include an electronic component (e.g., sensor **320**). The electronic component can be positioned on or housed in the display unit **305**. The electronic component can be a battery, a processor, a display, a camera, or any other electronic component. In some examples the electronic module can be attached to the frame **304**.
(36) In some examples, the electronic component (e.g., a sensor **320**) can be electrically connected

by a conductive fabric **316**_a-d_ that runs through the cover (e.g., **113**) of the light seal **312**. In some examples, the conductive fabric **316**_a-d_ runs through or across a retention band **309**. In some examples, the conductive fabric **316**_a_ runs through or across the frame **304**. In this manner, the conductive fabric **316**_a-d_ serves as an interconnect (i.e., electrical connection) between the sensor **320** on the light seal **312**. In some examples, the detections of the conductive fabrics **316**_a-d_ can be combined with other sensors on-board or remote from the HMD **300** to gather data is a sensor fusion manner. In the illustrated example, the light seal **312** include conductive fabrics **316**_a_ disposed on a left side of the light seal **312** and a conductive fabrics **316**_b_ disposed on a right side of the light seal **312**. The conductive fabrics **316**_a_ can be disposed in a specific touch sensitive surface and conductive fabrics **316**_b_ can be disposed in a specific touch surface **318**_b_. These specific touch sensitive surfaces, (e.g., **318**_b_) are configured to allow a user to provide input to the HMD **100** by touching the specific touch sensitive surfaces, (e.g., **318**_b_).

(37) In the illustrated example, the light seal **312** includes two touch sensitive surfaces **318**_b_, however, the present disclosure is not so limited and can include more or less than two touch sensitive surfaces. In some examples, the entire light seal **312** can be a touch sensitive surface that allows the user to input information or commands to the HMD **300** from any location on the light seal **312**. In some examples, there can be a distinct number of touch sensitive surfaces to enable the user to input information or commands into the HMD **300**. In some examples, each distinct touch sensitive surface can be directed to a specific type of input or functionality. For example, one touch sensitive surface can be for volume control, another touch sensitive input can be for scrolling, and the like. The HMD **300** can include an indicator that directs the user to the location of the distinct touch sensitive surfaces on the outer surface of the light seal **312**.

(38) In some examples, the HMD **300** can include a conductive fabric **316**_c_, **316**_d_ incorporated onto and/or into the retention band **309** of the HMD **300**. The retention band **309** can be a headband having flexible sections. The conductive fabric **316**_b_ can be configured to stretch or compress in response to the retention band **309** stretching or compressing. In some examples, the conductive fabric **316**_c_, **316**_d_ can generate signals indicative of the tightness or position of the retention band **309**. In some examples, a user can be notified based on the signals generated by the conductive fabric **316**_c_, **316**_d_. The retention band **309** can be automatically adjusted based on the signals generated by the conductive fabric **316**_c_, **316**_d_. In the illustrated example, the retention band **309** include conductive fabrics **316**_c_ disposed on a left side of the retention band **309** and a conductive fabrics **316**_d_ disposed on a right side of the retention band **309** and can be connected to electrical components **320** on the frame **304** of the HMD **300**.

(39) FIG. **3**B illustrates a top view of a user interacting with the touch sensitive surface **318**_b_. For case of illustration, the touch sensitive surface **318**_b_ depicts a single conductive fiber but can includes a plurality of conductive fibers. In some examples, the conductive fabric **316**_b_ is woven into a strain gauge pattern and the conductive fabric **316**_b_ is electrically connected to an electrical component (e.g., sensor **320**) of the HMD **300**. The user's engagement with the touch sensitive surface **318**_b_ can be interpreted as input to provide commands to the HMD **300**.

(40) In some examples, the conductive fabric **316**_b_ is physically connected to the sensor **320**. The sensor **320** can be a strain gauge and the conductive fabric **316**_b_ is physically coupled to the strain gauge **320**. The strain gauge **320** can measure the displacement of the conductive fabric **316**_b_ and interpret or transform the displacement of the conductive fabric **316**_b_ into input for the HMD **300**.

(41) In some examples, the touch sensitive surface **318**_b_ includes yarn that is physically connected to the strain gauge **320**. All the yarn disposed within a perimeter of the touch sensitive surface **318**_b_ can be physically connected to the strain gauge **320**. The touch sensitive surface **318**_b_ leverages the clastic nature of the yarn. In other words, as the user presses or touches the yarn of the touch sensitive surface **318**_b_, the strain is transferred to the strain gauge **320** that is disposed away from the touch sensitive surface **318**_b_ and the strain gauge can measure the displacement of the yarn and interpreted the displacement as input for the HMD **300**. In some examples, the touch sensitive

surface **318** can include both conductive fabric **316***b* and yarn.

(42) FIG. **3**B illustrates the user pushing or poking the specific touch sensitive surface **318***b* with a finger **10**, which displaces the conductive fabric **316***b* and transfers the displacement to the strain gauge **320**, which interprets the displacement as a commend or input to the HMD **300**. However, the user can use a number of different gestures with their finger **10** to provide input to the HMD **300**. As discuss above, the user can press (e.g., poke) against the touch sensitive surface **318***b*. The user can also slide their finger **10** along the touch sensitive surface **318***b*. The user can stretch the touch sensitive surface **318***b* by using two fingers to stretch the conductive fabric **316***b* between the two fingers or push the conductive fabric **316***b* closer together. This gesture can be interpreted as zooming in or zooming out. The user can also pinch the conductive fabric **316***a-d*. This gesture can be interpreted as taking a picture. In some examples, the number of fingers used in the gesture can indicate a different type of input. For example, two fingers swiping can be interpreted by the system as a different input relative to a single finger swiping, or three fingers swiping.

(43) The strain gauge **320** can be incorporated into the frame **304** of the HMD **300**. In some examples, the strain gauge **320** can be disposed on the frame **304** of the HMD **300**. In some examples, the strain gauge **320** can be disposed within the frame **304**. For example, the frame **304** can includes a slot in which the strain gauge **320** is disposed and the yarn and/or conductive fabric **316***b* can enter to physically connect to the strain gauge **320**. Accordingly, the strain gauge **320** is shielded from environmental conditions, such as sweat, fluid, debris, and the like.

(44) Any of the features, components, and/or parts, including the arrangements and configurations thereof shown in FIG. **3** can be included, cither alone or in any combination, in any of the other examples of devices, features, components, and parts shown in the other figures described herein. Likewise, any of the features, components, and/or parts, including the arrangements and configurations thereof shown and described with reference to the other figures can be included, either alone or in any combination, in the example of the devices, features, components, and parts shown in FIG. **3**.

(45) FIG. **4** illustrates a touch sensitive surface **418** on a light seal **412** of an HMD **400**. The HMD **400** can be substantially similar to, including some or all of the features of, the devices described herein, such as HMD **100**, **300** and light seal **212**. The touch sensitive surface **418** can include a distinct perimeter **419**. In the illustrated example, the perimeter **419** of the touch sensitive surface **418** is a circle, however, the perimeter **419** can include a plurality of different shapes. For example, the perimeter **419** can be semi-circular, ovoid, rectangular, trapezoidal, polygonal, triangular, and a variety of different shapes. As discuss above, the touch sensitive surface **418** can include a conductive fabric with conductive fibers (not shown) and/or yarn that can be connected to a strain gauge.

(46) The touch sensitive surface **418** can include an indicator to alert or guide the user to the touch sensitive surface **418**. For example, when the user is donning the HMD **400**, the user cannot see the outer surface of the light seal **412** or the touch sensitive surface **418** on the light seal **412** as the HMD **400** is intentionally blocking their view outside of light seal **412** and HMD **400**. Therefore, when the user is donning the HMD **400**, the user attempts to engage with the touch sensitive surface **418** blindly. The indicator can provide feedback to help to user locate the touch sensitive surface **418** in a variety of different ways so that the user can input commands to the HMD **400** using the touch sensitive surface **418**.

(47) In the illustrated example of FIG. **4**, the indicator can use tactile feedback to guide the finger **10** of the user to the touch sensitive surface **418**. For example, a plurality of projections **417** or bumps can project outward from the surface of a light seal **412** along the perimeter **419** of the touch sensitive surface. Therefore, when the user slides their finger **10** over the projections **417**, the user's feels a tactile sensation on the tip of their finger **10**. These tactile sensations can orient and alert the user to the perimeter of the touch sensitive surface **418**. In other words, as the finger **10** of the user approaches the touch sensitive surface **418** the projections **417** provide tactile feedback to the user

to know that they have arrived at the touch sensitive surface **418**. The projections **417** can be spaced along the perimeter **419** of the touch sensitive surface **418**. The space between adjacent projections **417** may be less than the width a fingertip, so that user can feel it. In some examples, the projection **417** may be a continuous projection that extends along the entire perimeter **419** of the touch sensitive surface **418**. In this manner, the user knows when they are approaching the perimeter **419** of the touch sensitive surface **418**, either from the outside of the touch sensitive surface **418** or from the inside of the touch sensitive surface **418**.

(48) The projections **417** can have a variety of different shapes. In the illustrated example, the projections **417** have a circular shape. However, the scope of the present disclosure incorporates a variety of different shapes for the projections, such a rectangular, triangular, polygonal, and the like.

(49) In some examples, the projections **417** can be positioned in patterns to help orient the user. For example, the bottom portion of the perimeter **419** can have a different pattern than the rest of the perimeter **419**. For example, the bottom portion of the perimeter can have a cluster of three projections **419** that are closer to each other to indicate to the user that they are approaching the bottom portion of the perimeter **419** of the touch sensitive surface **418**. Similarly, a top portion of the perimeter **419** can have a similar pattern as the bottom portion of a different pattern. The same goes for a left portion of the perimeter **419** and a right portion of the perimeter **419**.

(50) In some examples, the tactile feedback can be dynamic. In other words, in some examples the projections **417** can be felt, and in other examples the projections **417** cannot be felt. For example, in situations where the touch sensitive surface **418** is turned on and active, the projections **417** can be felt and in situations where the touch sensitive surface **418** is turned off and not active the projections **417** cannot be felt. In some examples, the projections **417** can be part of an inflatable bladder that inflates to make the projections **417** project outward from the outer surface of the light seal **412** and deflate to make the projections **417** retract back into the light seal **412**. In some other examples, the projections **417** can be selectively activated by a solenoid or other electrically actuated system that extends the projections **417** outward from the outer surface of the light seal **412** when the touch sensitive surface **418** is active, and retracts the projections **417** when the touch sensitive surface **418** is not active. As discussed below in more detail, the touch sensitive surface **418** can become active when a position sensor detects a near touch. When a near touch is detected, the touch sensitive surface **418** can be turned on and the projections **417** can be activated and extended.

(51) In other examples, the indicator can include visual feedback that alerts or guides the finger **10** of the user to the touch sensitive surface **418**. Visual feedback can be displayed on a display **405** of the HMD **400** to the user. The HMD **400** can include a sensor, such as a camera, that is disposed on the frame **404** of the HMD **400**. The sensor can capture images or video of the touch sensitive surface **418** on the outer surface of the light seal **412**. Accordingly, the display **405** can display the images or video from the sensor directly to the user on the display **405** to show the user where their finger **10** is in relation to the touch sensitive surface **418** to help the user find and utilize the touch sensitive surface **418**.

(52) In another example, the display **405** can merely display animations or visual cues to the user to orient the finger **10** of the user toward the touch sensitive surface **418**. For example, the display **405** can display to the user an animation, rather than a real-time video or image of how close the finger **10** of the user is relative to the touch sensitive surface **418**. The animations or visual cues may be display in a corner on a peripheral of the display **405** so that the animations or visual cues are not overlap over the central area of the display **405**.

(53) In another example, an inner surface of the light seal **412** can include a plurality of light emitting diodes. The light emitting diodes can be used to provide feedback to the user to guide the user to the touch sensitive surface **418**. In some examples, the light emitting diodes can outline the touch sensitive surface **418** on the inner surface of the light seal **412**. When the light emitting

diodes light up, the user can see the relative location of the touch sensitive surface **418**, albeit, from the inside of the light seal **412**. In some examples, the light emitting diodes on the inner surface of the light seal **412** may light up to show the user the current location of the finger **10** of the user from the inside of the light seal so that user can see the approximate location of their finger **10** relative to the touch sensitive surface **418**.

(54) In another example, the color of the light emitting diodes can change color based on the location of the finger **10** of the user relative to the location of the touch sensitive surface **418**. For example, the light emitting diode can transition from a red color to a yellow color to a green color based on the location of the finger **10**. The light emitting diode can be red when the finger **10** of is not near the touch sensitive surface **418**, transition to a yellow color as the finger **10** get closer to the perimeter **419** of the touch sensitive surface **418** and turn green when the finger **10** engages the touch sensitive surface **418**.

(55) In some examples, the indicator can include haptic feedback. The light seal **412** can include a haptic engine **434** that is electrically connected to processor **430** via a wire **432**. The haptic engine is configured to provide haptic feedback (e.g., vibration) to the user when their finger **10** approaches the perimeter **419** of the touch sensitive surface **418**. The vibration of the haptic engine **434** can orient and alert the user to the perimeter **419** of the touch sensitive surface **418**. In other words, as the finger **10** of the user approaches the touch sensitive surface **418** the haptic engine **434** vibrates to provide feedback to the user to know that they have arrived at the touch sensitive surface **418**. In this manner, the user knows when they are approaching the perimeter **419** of the touch sensitive surface **418**, either from the outside of the touch sensitive surface **418** or from the inside of the touch sensitive surface **418**.

(56) The processor **430** can also perform a variety of different functions, including communicating with each of the feedback mechanisms discussed above. The processor **430** can function as a triggering device that can turn on and turn off the touch sensitive surface. In an attempt to conserve power, the touch sensitive surface **418** can be turned on for a user to provide input to the HMD **400** and turned off when the touch sensitive surface **418** is not in use. The processor **430** can be in communication with a number of different sensors.

(57) The processor **430** can be in communication with a position sensor that detects a near touch, which is when the finger **10** or hand of the user is within a predetermined distance of the touch sensitive surface **418**. For example, the processor **430** can be in communication with a plurality of proximity sensors that are disposed around the perimeter **419** of touch sensitive surface **418** or disposed within the touch sensitive surface **418**. The proximity sensor can detect a near touch. Accordingly, when the proximity sensor senses a near touch, the processor **430** triggers the touch sensitive surface **418** to turn on so that the user can engage with the touch sensitive surface **418**. In other words, the processor **430** can turn on the touch sensitive surface **418** when the sensor detects a near touch.

(58) In another example, the processor **430** can be in communication with a camera that captures images and/or video of the touch sensitive surface **418**. The camera monitors the touch sensitive surface **418** on the outer surface of the light seal **412** and captures images and/or video of the touch sensitive surface **418**. When the camera detects a near touch, the processor **430** determines that the user is about to touch the touch sensitive surface **418** and triggers the touch sensitive surface **418** to turn on so that the user can engage with the touch sensitive surface **418**.

(59) The HMD **400** can use a number of different position sensors, such as proximity sensors, cameras, capacitance sensors, or any other type of sensor to detect a near touch (e.g., the approach of the user's finger, hand, etc. to trigger turning on the touch sensitive surface **418**). These systems can be used to avoid having environmental factors, such as fluid, water, humidity, sweat, accidently engaging with the touch sensitive surface **418** and triggering input to the HMD **400** when the user was not intending to.

(60) FIGS. **5-8**B illustrate additional ways in which the user can provide input for the HMD in a

variety of different manners. FIG. **5** illustrates an HMD **500** with a frame **504**. The frame **504** of the HMD **500** is coupled to the light seal **512**. The light seal **512** includes a touch sensitive surface **518** that is disposed on an outer surface of a light seal **512**. In the illustrated example, the touch sensitive surface **518** can include a plurality of conductive fabrics **516** organize (e.g., weaved) in a specific pattern. In the illustrated example, the conduct fabric **516** is organized in a matrix pattern. When the conductive fabric **516** is organized in this pattern, the conductive fabric **516** can track the movement of the finger **10** along the touch sensitive surface **518**. The conductive fabrics **516** can be spaced apart a predetermined distance such that environmental factors can not adversely affect input to the touch sensitive surface **518**.
(61) FIG. **6** illustrates an HMD **600** with a frame **604**. The frame **604** of the HMD **600** is connected to the light seal **612**. The light seal **612** includes a touch sensitive surface **618** that is disposed on an outer surface of a light seal **612**. In the illustrated example, the touch sensitive surface **618** includes a plurality of planes **616** that are woven into the light seal **612** and are spaced vertically from each other. The planes **616** can get a capacitance reading to track the movement of the finger **10** of the user. In other words, the finger **10** can do a swiping motion or gesture in a vertical direction and the planes **616** can track the movement. This gesture can be used for volume control or scrolling. In some examples, the planes **616** can be spaced horizontally form each other and the user can do a swiping motion or gesture in a horizontal direction.
(62) FIG. **7** illustrates an HMD **700** with a frame **704**. The frame **704** can include a sensor **720**. The sensor **720** can be an accelerometer that can detect vibrations in the frame **704**. Accordingly, the user can tap the frame **704** of the HMD **700** with their finger **10**. Tapping on the frame **704** can interpreted as input from the user to the HMD **700**.
(63) FIGS. **8**A and **8**B illustrate an HMD **800** with a frame **804**. The frame **804** can include a sensor **820**. The sensor **820** can be a strain gauge that can detect mechanical deflection of the frame **804**. FIG. **8**A illustrates the frame **804** in a natural or unconstrained state. FIG. **8**B illustrates the frame **804** in constrained state in which the user is squeezing a top and a bottom of the frame **804** toward each other, thereby mechanically deflecting the frame **804**. The deflection of the frame **804** can be interpreted as input to the HMD **800**. For example, squeezing the HMD **800** as illustrated can be interpreted as a command to take a picture of the display of the HMD **800**.
(64) In some examples, the present system and method may collect, store, and/or use personal information data to adapt and/or improve the user experience. While not necessary to operate the present system and method, if such personal information is collected, stored, used, transmitted, or otherwise used, such use should be conducted according to well-established, generally accepted privacy policies and/or privacy practices.
(65) The foregoing description, uses specific nomenclature to provide a thorough understanding of the described embodiments. However, the specific details are not necessary in order to practice the described examples. Therefore, the foregoing descriptions of the specific embodiments and examples are presented for purposes of illustration and description. They are not intended to be exhaustive or to limit the embodiments to the precise forms disclosed. Rather, many modifications and variations are possible in view of the above teachings.

Claims

1. A head-mountable device comprising: a display; a frame at least partially surrounding the display; a retention support coupled to the frame; a facial interface attached to the frame; a cover disposed around the facial interface and configured to extend between the frame and a face of a user and contact the face, the cover comprising: a first surface configured to contact the face of the user; and a second surface extending from the first surface and configured to be exposed to an exterior environment when the user dons the head-mountable device; and a touch sensitive surface incorporated into the second surface of the cover to receive input from the user for the head-

mountable device.
2. The head-mountable device of claim 1, further comprising a first distinct touch sensitive surface and a second distinct touch sensitive surface disposed on an outer surface of the cover.
3. The head-mountable device of claim 1, further comprising a strain gauge disposed in the frame and electrically connected to the touch sensitive surface.
4. The head-mountable device of claim 3, wherein the touch sensitive surface comprises a conductive fabric.
5. The head-mountable device of claim 1, wherein: the touch sensitive surface is disposed on an outer surface of the cover and includes a distinct perimeter; and the head-mountable device comprises an indicator to direct the user to the touch sensitive surface.
6. The head-mountable device of claim 5, wherein the indicator comprises a projection that extends outward from the cover along a perimeter of the touch sensitive surface.
7. The head-mountable device of claim 5, wherein the indicator comprises a visual cue generated on the display.
8. The head-mountable device of claim 5, wherein the indicator comprises a light emitting diode positioned on an inner surface of the cover to guide the user to the touch sensitive surface.
9. The head-mountable device of claim 5, wherein the indicator comprises a haptic engine disposed in the cover to provide haptic feedback to the user to guide the user to the touch sensitive surface.
10. The head-mountable device of claim 1, further comprising a position sensor configured to detect a near touch of the touch sensitive surface; and a processor disposed on the frame, the processor configured to turn on the touch sensitive surface when the sensor detects the near touch.
11. The head-mountable device of claim 10, wherein the position sensor comprises a camera.
12. A wearable electronic device, comprising: a display; a frame; a light blocking material attached to the frame, the light blocking material comprising: a first surface configured to contact a face of a user; and a second surface extending from the first surface and configured to be exposed to an exterior environment when the user dons the wearable electronic device; and an input sensor configured to detect an input on the second surface of the light blocking material.
13. The wearable electronic device of claim 12, wherein the input sensor comprises an accelerometer disposed within the frame.
14. The wearable electronic device of claim 12, wherein the input sensor comprises: a first capacitance sensor disposed within the light blocking material; and a second capacitance sensor disposed within the light blocking material adjacent to the first capacitance sensor.
15. The wearable electronic device of claim 12, wherein the input sensor comprises a strain gauge connected to fabric in the light blocking material.
16. The wearable electronic device of claim 12, wherein the input sensor comprises a strain gauge disposed with in the frame to detect a deflection of the frame.
17. The wearable electronic device of claim 12, wherein the input sensor comprises a conductive fabric in a matrix shaped pattern.
18. A cover removably attachable to a head-mountable display, the cover comprising: a body including an inner surface configured to contact a face of a user and an outer surface configured to be exposed to an exterior environment when the user dons the head-mountable display; a removable fastener attached to the body; and a touch sensitive surface disposed on the outer surface of the cover.
19. The cover of claim 18, wherein the touch sensitive surface comprises a conductive fabric that forms a strain gauge.
20. The cover of claim 18, wherein the inner surface of the cover comprises a first light emitting diode, and a second light emitting diode; wherein the first light emitting diode and the second light emitting diode are positioned to guide a user to the touch sensitive surface.