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ADJUSTMENT MECHANISM

Abstract

An apparatus can include a display, a facial interface, and a connection between the display and facial interface. The display can at least translate or rotate relative to the facial interface via the connection.

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Background/Summary

CROSS-REFERENCE TO RELATED APPLICATION(S) [0001] This is a continuation of U.S. application Ser. No. 18/472,193, filed 21 Sep. 2023, and entitled “Adjustment Mechanism,” which claims priority to U.S. Provisional Application No. 63/376,761, filed 22 Sep. 2022, and entitled “Adjustment Mechanism,” the entire disclosures of which are hereby incorporated by reference.

FIELD

[0002] The described embodiments relate generally to adjustment mechanisms of a head-mountable device. More particularly, the present embodiments relate to adjustment mechanisms in a head-mountable device for altering tilt and eye relief of a head-mountable device.

BACKGROUND

[0003] Recent advances in portable computing have enabled head-mountable devices (HMD) that provide augmented and virtual reality (AR/VR) experiences to users. These HMDs have many components, such as a display, viewing frame, lens, batteries, and other components. Certain components of the HMD can also help create a unique user experience. HMDs typically include a display, where a user can view and interact with visualizations presented on the display screen of the HMD. Users of HMDs have myriad different head sizes, shapes, and contours of facial features which should be properly accommodated by the HMD for the user to have an optimum viewing experience.

[0004] In some instances, a user may desire to share the HMD with another user. Unfortunately, conventional HMDs are not typically customizable for certain users (e.g., with differently sized facial features or eyesight needs). Thus, these users may be unable to wear a conventional HMD or simply be uncomfortable doing so.

[0005] Indeed, user friendly adjustments in conventional HMDs are implemented in rudimentary ways (if any) that typically limit a user experience or ineffectively position the display screen on the user's face. For example, a user may have a facial feature that is different from the HMD design form factor, thereby positioning the HMD incorrectly on the user's head and creating an undesirable viewing experience. Therefore, devices and systems of a head-mountable device capable of intuitively positioning the head-mountable device relative to a user are desirable.

SUMMARY

[0006] In at least one example of the present disclosure, an apparatus includes a display, a facial interface, and a connection between the display and facial interface, the display being translatable or rotatable relative to the facial interface via the connection.

[0007] In one example, the connection includes a depth adjustment mechanism that, when adjusted, translates the display towards or away from the facial interface. In one example, the connection includes an angular adjustment mechanism that, when adjusted, rotates the display up or down relative to the facial interface. In one example, the connection includes an automated actuator or a manual actuator. In one example, the manual actuator is operable from a single interface location. In one example, the connection includes an adjustment resolution for transitioning between a first state and a second state. In one example, the adjustment resolution is non-continuous.

[0008] In at least one example of the present disclosure, a head-mountable device includes a display, a facial interface, a strap connected to at least the display (e.g., the display frame) or the facial interface, and an actuator moveably constraining the display relative to the facial interface.

[0009] In one example, the actuator includes an actuator control including a lever, a button, a dial, a rocker, a slider, or a toggle. In one example, the actuator control is positioned at a top portion or a side portion of the display or the facial interface. In one example, the actuator control is accessible when the apparatus is donned. In one example, the actuator actuates in response to voice commands or gestures. In one example, the actuator provides two degrees of freedom for the display relative to the facial interface. In one example, a first degree of freedom includes a linear translation, and a second degree of freedom include an angular tilt.

[0010] In at least one example of the present disclosure, a wearable electronic device includes a display, a facial interface, an angular adjustment connection between the display and the facial interface, and a linear adjustment connection between the display and the facial interface.

[0011] In one example, the angular adjustment connection includes a linkage that, when extended or retracted, pivots the display relative to the facial interface. In one example, the linear adjustment connection includes a member that, when actuated, increases or decreases a linear distance between the display and the facial interface. In one example, the angular adjustment connection or the linear adjustment connection is dynamically adjustable for multiple users. In one example, the angular adjustment connection and the linear adjustment connection include adjustable pillars. In one example, the adjustable pillars are positioned in a forehead region, a zygoma region, or maxilla region when the apparatus is donned.

[0012] Another aspect of the present disclosure relates to a wearable apparatus. The wearable apparatus can include a head-mountable display, a facial interface, and a connection movably constraining the head-mountable display relative to the facial interface in a first degree of freedom including linear translation and a second degree of freedom including angular tilt.

[0013] In one example, the connection includes a linear slide. In one example, the linear slide is back-drivable. In at least one example, the wearable apparatus further includes a lock engageable with the linear slide. In certain examples, the linear slide includes a first set of teeth, and the lock includes a second set of teeth engageable with the first set of teeth. In one example, the first set of teeth and the second set of teeth include leading tips. In a particular example, when the first set of teeth and the second set of teeth are engaged, the leading tips of the second set of teeth protrude past the first set of teeth, and the leading tips of the first set of teeth protrude past the second set of teeth. Further, in one example, the wearable apparatus can include a control to engage and disengage the lock and the linear slide. In some examples, the control is positionable adjacent to a maxilla region of a human face when the wearable apparatus is donned. In a specific example, the control is connected to the lock via a flexible drive shaft.

[0014] Yet another aspect of the present disclosure relates to a head-mountable device. The head-mountable device can include a display frame, a display disposed within the display frame, a facial interface, an arm connected to the display frame, and a linear slide movably constraining the display relative to the facial interface, the linear slide including a lock.

[0015] In one or more examples, the lock is deflectable in a first direction. In one example, the lock is translatable in a second direction perpendicular to the first direction. In a specific example, the linear slide is translatable in a third direction perpendicular to the first direction and the second direction. In some examples, the arm is connected to the display frame via a pivot connection, and the display frame is rotatable about the pivot connection independent of the arm.

[0016] Yet another aspect of the present disclosure relates to a wearable electronic device. The wearable electronic device can include a display, a facial interface, an angular adjustment connection between the display and the facial interface, and a linear adjustment connection between the display and the facial interface. The linear adjustment connection can include a set of actuators, a set of actuator locks engageable with the set of actuators, and an actuator control to manipulate the set of actuator locks.

[0017] In one or more examples, the set of actuators includes a pair of side slides and a pair of top slides. In one example, the actuator control includes a button. In one or more examples, upon depressing the actuator control, the set of actuator locks are disengaged from the set of actuators and the set of actuators is adjustable to translate the facial interface toward or away from the display. In at least one example, upon releasing the actuator control, the set of actuator locks are engaged with the set of actuators, and the set of actuators is positionally locked in place to inhibit translation of the facial interface toward or away from the display.

Description

BRIEF DESCRIPTION OF THE DRAWINGS

[0018] 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:

[0019] FIG. **1** shows a top view profile of a head-mountable device including a facial interface.

[0020] FIG. **2**A shows a side view profile of a head-mountable device including a facial interface.

[0021] FIG. **2**B shows a top view profile of a head-mountable device including a facial interface.

[0022] FIGS. **3**A-**3**D show exemplary locations of adjustment mechanism of a head-mountable device.

[0023] FIGS. **4**A-**4**C show exemplary translatable positions of an adjustment mechanism.

[0024] FIGS. **5**A-**5**C show exemplary rotatable positions of an adjustment mechanism of a head-mountable device.

[0025] FIGS. **6**A-**6**B show an exemplary adjustment mechanism.

[0026] FIGS. **7**A-**7**B show an exemplary rotatable adjustment mechanism.

[0027] FIG. **8** shows another exemplary adjustment mechanism.

[0028] FIGS. **9**A-**24**B respectively show example head-mountable devices with an actuator control.

[0029] FIGS. **25**A-**25**D show an example head-mountable device with an example connection and corresponding actuator control.

[0030] FIG. **26** shows an example connection of a head-mountable device.

[0031] FIG. **27** shows another example connection of a head-mountable device.

[0032] FIGS. **28-30** respectively show top, front, and side views of another example head-mountable device.

[0033] FIGS. **31-33** respectively show a perspective view of lock-slider disengagement, a front view of lock-slider disengagement, and a front view of lock-slider engagement of a portion of a linear adjustment connection.

[0034] FIG. **34** illustrates a perspective view of a portion of a head-mountable device having multiple linear adjustment connections, according to one exemplary embodiment.

DETAILED DESCRIPTION

[0035] 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. Instead, the following descriptions are 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.

[0036] The following disclosure relates to adjustment mechanisms of a head-mountable device (e.g., for AR/VR experiences). More particularly, the present embodiments relate to adjustment mechanisms of a head-mountable device for altering angle and/or distance of a head-mountable device relative to the user head (or eyes). These adjustment mechanisms include depth (e.g., translation) adjustments and/or angular (e.g., rotation) adjustments.

[0037] In one example, a head-mountable device includes a connection between a display and a facial interface. The connection allows the display to be translatable or rotatable relative to the facial interface. The translatable or rotatable movements allow the head-mountable device to achieve positions and combinations of positions that otherwise could not be achieved.

[0038] Conventional head-mountable devices do not include connections between the display and facial interfaces that allow translatable or rotatable movements. Therefore, conventional head-mountable devices do not allow the movement required to adjust depth for eye relief or angular adjustments to optimize viewing. Thus, conventional head-mountable devices cannot accommodate for different facial profiles, viewing preferences, eyesight capacities, etc.

[0039] By contrast, a head-mountable device of the present disclosure provides connections allowing translatable or rotatable motion relative to a facial interface. Such a head-mountable device has many advantages over a conventional head-mountable device. A head-mountable device with connections allowing movement of a display relative to the user's face allows a user to adjust the depth and angle of the display screen as needed to accommodate their personal preferences or requirements. Additionally, a head mountable display with connections allows motion of the display relative to different users' faces, thereby improving a share-ability of head-mountable device over conventional HMDs.
[0040] As disclosed herein, controlling the movement (e.g., linear translation or angular tilt) of a head-mounted display entails user friendly and simple actuation controls (e.g., lever, button, dial, rocker, slider, toggle, etc.) that are intuitive and easy to manipulate. Several examples of these devices are discussed below.
[0041] In one example, a head-mountable device includes a display, a strap connected to the display (e.g., the display frame), a facial interface, which is customizable to a user's facial profile, and a connection. The connection can be between the display and the facial interface such that the display is translatable and/or rotatable relative to the facial interface via the connection.
[0042] In another example, a head-mountable device includes a display, a strap connected to the display (e.g., the display frame), a facial interface, which is customizable to a user's facial profile, and an actuator. The actuator can moveably constrain the display relative to the facial interfaces.
[0043] In yet another example, a head-mountable device includes a display, a facial interface, which is customizable to a user's facial profile, and an angular and linear adjustment connection between the display and facial interface.
[0044] Accordingly, the apparatus and systems described herein provide angular and linear adjustments for a display of a head-mountable device in a user-friendly way, creating an enhanced more customizable user experience.
[0045] These and other embodiments are discussed below with reference to FIGS. **1-34**. 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).
[0046] FIG. **1** illustrates a top view profile of a head-mountable device **100** worn on a user head **101**. While the present systems and methods are described in the context of a head-mountable device **100**, the systems and methods can be used with any wearable apparatus, or any apparatus or system that can be physically attached to a user's body but are particularly relevant to an electronic device worn on a user's head. The head-mountable device **100** can include a display **102** (e.g., one or more optical lenses or display screens in front of the eyes of the user). The display **102** can include a display for presenting augmented reality visualizations, a virtual reality visualization, or other suitable visualization. The display **102** can also include a display frame **105** that houses optical components of the display **102**. It will therefore be appreciated that when referencing the display **102** herein, the display frame **105** can be implemented as part of specific aspects or functionality for the display **102**. For example, connection(s) **106** (described further below) can connect the facial interface **104** to at least one of the display **102** (e.g., optical elements of the display **102**) or structural elements of the display **102** (e.g., the display frame **105**).
[0047] The head-mountable device **100** also includes a facial interface **104** and a connection(s) **106** between the display **102** (e.g., the display frame **105**) and the facial interface **104**. As used herein,

the term "facial interface" refers to a portion of the head-mountable device **100** that engages a user face via direct contact. In particular, a facial interface includes portions of the head-mountable device **100** that conform to (e.g., compress against) regions of a user face. To illustrate, a facial interface can include a pliant (or semi-pliant) face track that spans the forehead, wraps around the eyes, contacts the zygoma and maxilla regions of the face, and bridges the nose. In addition, a facial interface can include various components forming a structure, webbing, cover, fabric, or frame of a head-mountable device disposed between the display **102** and the user skin. In particular implementations, a facial interface can include a seal (e.g., a light seal, environment seal, dust seal, air seal, etc.). 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 some ambient light is blocked and a complete light seal where all ambient light is blocked when the head-mountable device is donned).

[0048] In addition, the term "connection" refers to a joining between the display **102** (e.g., via the display frame **105**) and the facial interface **104**. In some examples, a connection allows the display **102** to translate or rotate relative to the facial interface **104**. In other examples, a connection allows the display **102** to both translate and rotate relative to the facial interface **104**. For instance, the connection(s) **106**, when adjusted, can slide (e.g., translate) the display **102** toward or away from the facial interface **104** (e.g., in a linear fashion). In another example, the connection(s) **106**, when adjusted, can rotate the display **102** up or down relative to the facial interface **104** (e.g., in an angular fashion). Thus, a connection can slidably join or rotatably join the display **102** and the facial interface **104**.

[0049] In this manner, the connection(s) **106** can movably constrain the display **102** relative to the facial interface **104**. As used herein, the term "movably constrain" or "movably constraining" refers to the type of connection that can dynamically move (e.g., translate or rotate), yet retain control over a particular element's movement or position. For example, to "movably constrain" means the connection(s) **106** can bound movement of the display **102** within two degrees of freedom (e.g., along a horizontal plane and along an additional plane non-planar with the horizontal plane) relative to the facial interface **104**.

[0050] The connection(s) **106** can include one or more components (e.g., actuators, sliders, gears, levers, mechanical advantage devices, posts, mechanical stops, dampeners, etc.) that can allow (or actively provide) translation or rotation of the display **102** relative to the facial interface **104**. The connection(s) **106** can have an adjustable resolution that is a continuous resolution or a non-continuous resolution, and capable of transitioning between states (e.g., between a first display position and a second display position). The connection(s) **106** can include a manual actuator control or an automated actuator control that is operable from a single interface location (or multiple interface locations).

[0051] In certain implementations, the connection(s) **106** are positioned between inner and outer surfaces of the head-mountable device **100**. As used herein, an "outer surface" refers to an exterior surface of the head-mountable device **100** that outwardly faces the ambient environment. By contrast, as used herein, an "inner surface" refers to an exterior surface of the head-mountable device **100** that is oriented to face towards (or contact) a human face or skin.

[0052] Furthermore, the connection **106** can include a variety of different adjustment mechanisms, members, or movement mechanisms or movable connectors (e.g., bearings/bushings, dovetail slides, scissor mechanisms, sarrus linkages, gears, movable arms, etc.), cables (e.g., tensioned cables), actuators (e.g., mechanical, electromechanical, hydraulic, pneumatic, piezoelectric, etc.), and locking mechanisms (toggles, latches, ratchets, clamps, friction brakes, toothed brakes, hydraulic brakes, pneumatic bladders, non-back-drivable mechanisms, etc.), and other components. Locations of the connection **106** can be modified or tuned, as can the number of connections. For instance, the location and/or the number of the connection(s) **106** can correlate to an amount of force or pressure exerted on the user at any one datum (e.g., forehead region, maxilla region, zygoma region, etc.). In other instances, the location and/or the number of the connection(s) **106** can correspond to rigidity (or rigidity variances) between the connection(s) **106**.

[0053] As used herein, the term “forehead region” refers to an area of a human face between the eyes and the scalp of a human. Additionally, the term “zygoma region” refers to an area of a human face corresponding to the zygomatic bone structure of a human. Similarly, the term “maxilla region” refers to an area of a human face corresponding to the maxilla bone structure of a human.

[0054] Additionally shown in FIG. **1**, the head-mountable device **100** includes one or more arms **108**, **110**. The arms **108**, **110** are connected to the display **102** and extend distally toward the rear of the head. The arms **108**, **110** are configured to secure the display in a position relative to the user head **101** (e.g., such that the display **102** is maintained in front of a user's eyes). For example, the arms **108**, **110** extend over the user's ears **112**. In certain examples, the arms **108**, **110** rest on the user's ears **112** to secure the head-mountable device **100** via friction between the arms **108**, **110** and the user head **101**. For example, the arms **108**, **110** can apply opposing pressures to the sides of the user head **101** to secure the head-mountable device **100** to the user head **101**. Optionally, the arms **108**, **110** can be connected to each other via a strap **103** (shown in the dashed lines) that can compress the head-mountable device **100** against the user head **101**. In particular examples, the strap **103** is connected to at least the frame of the display **102** or the facial interface **104**.

[0055] In specific examples, the arms **108**, **110** are connected to the display **102** (by way of the display frame **105**) via a pivot joint **114**. The pivot joint **114** can be external or internal with respect to the arms **108**, **110** and/or the display frame **105**. In these or other examples, the pivot joint **114** can allow the display frame **105** to rotate about the pivot joint **114** independent of the arms **108**, **110**. To do so, the pivot joint **114** can include a detent hinge, a friction hinge, a passive hinge, a full lock-out hinge, etc.

[0056] Any of the features, components, and/or parts, including the arrangements and configurations thereof shown in FIG. **1** 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**.

[0057] FIGS. **2**A-**2**B respectively illustrate side and front view profiles of an example of the head-mountable device **100**. As discussed above, the head-mountable device **100** includes the display **102**, the facial interface **104**, and the connection(s) **106**. In particular, as shown in FIGS. **2**A-**2**B, the facial interface **104** can indeed wrap around the eyes **201**, bridge the nose **202**, span the forehead **203**, and contact the zygoma and maxilla regions **205** of the face.

[0058] Additionally shown in FIGS. **2**A-**2**B, the head-mountable device **100** includes sensors **204** which can be attached to (or embedded within) the facial interface **104**. As used herein, the term “sensor” refers to one or more different sensing devices, such as a camera or imaging device, temperature device, oxygen device, movement device, brain activity device, sweat gland activity device, breathing activity device, muscle contraction device, etc. some particular examples of sensors include an electrooculography sensor, electrocardiogramsor, EKG sensor, heart 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.

[0059] Further below, this disclosure describes with more particularity how the connection(s) **106** as adjustment mechanisms can be positioned within the head-mountable device **100**. In addition, subsequent portions of this disclosure provide additional detail with respect to user interactions for controlling or actuating adjustment mechanisms.

[0060] Any of the features, components, and/or parts, including the arrangements and configurations thereof shown in FIGS. **2**A-**2**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 FIGS. **2**A-**2**B.

[0061] The location and positioning of the connection(s) **106** can provide a stable yet flexible and adjustable interface between the facial interface **104** and the display **102**. In accordance with one or more examples of the present disclosure, FIGS. **3**A-**3**D illustrate a plurality of positions where the connection(s) **106** can be located between the display **102** and the facial interface **104**. Although FIGS. **3**A-**3**D illustrate particular locations, it will be appreciated that the locations of the connection(s) **106** can be modified within the scope of the present disclosure.

[0062] In one example, FIG. **3**A, shows the connection(s) **106** includes a single adjustment mechanism located at the forehead **203** of a user. The connection(s) **106** can be configured to provide a linear or angular connection between the display **102** and the facial interface **104**. In particular implementations, the connection(s) **106** provides only angular (tilt) adjustment by pivoting the display **102** relative to the facial interface **104**.

[0063] In at least some instances, a single-point system as shown in FIG. **3**A can provide the simplest and most direct means of adjustment. For example, the connection(s) **106** in FIG. **3**A can avoid potential angular misalignment or racking issues of multi-point systems. As another example, the connection(s) **106** in FIG. **3**A can facilitate single-handed user adjustment of the head-mountable device **100**.

[0064] FIG. **3**B shows another example where the connection(s) **106** include two adjustment mechanisms oppositely positioned between the facial interface **104** and the display **102**. Specifically, the connection(s) **106** in FIG. **3**B include a first adjustment mechanism on a left side and a second adjustment mechanism on a right side (e.g., near regions of the user eye). Similarly, in another example, the connection(s) **106** may be located near the zygoma or maxilla regions **205** of the face. The two connections can provide at least two points of angular or linear adjustment of the display **102** relative to the facial interface **104**. For example, both of the connection(s) **106** in FIG. **3**B can be adjusted linearly together to provide a depth adjustment or adjusted angularly together to provide a vertical (up/down) tilt adjustment. In another example, one of the connections **106** can be extended outward and the other of the connection(s) **106** can be pushed inward (so as to provide a side-to-side or horizontal tilt adjustment).

[0065] FIG. **3**C shows the connection(s) **106** include three adjustment mechanisms-one near the forehead **203** and two at bottom corner areas at the zygoma or maxilla regions. Additionally, FIG. **3**D shows the connection(s) **106** include four connection(s) **106**-two at the top corners and two at the bottom corners. In at least some examples, multi-point systems like those shown in FIGS. **3**B-**3**D can provide improved load distribution and/or rigidity. Multi-point systems like those shown in FIGS. **3**B-**3**D can also satisfy larger load requirements, such as increased loads during a sudden impact event to the head-mountable device **100**. In the case of multi-point systems, synchronization mechanisms can be added to ensure that each of the connection(s) **106** move in lockstep.

[0066] Any of the features, components, and/or parts, including the arrangements and configurations thereof shown in FIGS. **3**A-**3**D 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 FIGS. **3**A-**3**D. Moreover, although not shown, it will be appreciated that more than four of the connection(s) **106** are also contemplated, and the locations of any one the connection(s) **106** described can vary in position and location relative to the figures in which they were described.

[0067] As mentioned above, the connection(s) **106** can include adjustment mechanisms that allow (or provide) movement of the display **102** relative to the facial interface **104**. This movement can include motion in a single degree of freedom or multiple degrees of freedom. In accordance with one or more such examples, FIGS. **4**A-**4**C illustrate an example of depth adjustment via depth adjustment mechanisms **402** (e.g., linear adjustment connections). For example, FIG. **4**A shows the display **102** positioned relative to the facial interface **104** in a home state. In the home state, depth adjustment mechanisms **402** can be positioned at a default position, a customized position, etc. in which the display **102** is a predetermined distance (i.e., eye relief distance) away from the facial interface **104**. In other instances, the home state can include a current positioning of the display **102** relative to the display **102**.

[0068] FIG. **4**B shows the depth adjustment mechanisms **402** in an extended state. In the extended state, the depth adjustment mechanisms **402** are extended or otherwise altered from the home state (or another state) to increase a relative distance between the display **102** and the facial interface **104**.

[0069] FIG. **4**C shows the depth adjustment mechanisms **402** in a retracted state. In the retracted state, the depth adjustment mechanisms **402** are retracted or otherwise altered from the home state (or another state) to decrease a relative distance between the display **102** and the facial interface **104**.

[0070] In some examples, the various states shown in FIGS. **4**A-**4**C can include discrete or predefined positions of the display **102** relative to the facial interface **104**—where the predefined positions are differentiated by set (or customizable) step-sizes. For instance, the depth adjustment mechanisms **402** can be utilized to vary the position of the display **102** relative to the facial interface **104** in positional steps from 0 mm eye relief distance in a fully retracted state, to 6 mm eye relief distance in a fully extended state. In other examples, however, the various states shown in FIGS. **4**A-**4**C can include non-discrete positions of the display **102** relative to the facial interface **104**—where the positions are configurable via continuous adjustment of the depth adjustment mechanisms **402**, due to a continuous interface that is gradually adjusting over a substantially smooth surface, providing a continuous adjustment resolution.

[0071] Adjustment of the depth adjustment mechanisms **402** can be performed in different ways. In some examples, user interactions to the depth adjustment mechanisms **402** (e.g., via one or more user controls) can actuate or move the depth adjustment mechanisms **402**. Additionally, or alternatively, the depth adjustment mechanisms **402** can actuate in response to one or more sensors of the head-mountable device **100** detecting a voice command or gesture (e.g., eye gesture, hand gesture, touch, etc.). Still further, in some examples, the head-mountable device **100** can automatically adjust the depth adjustment mechanisms **402** (e.g., based on one or more sensors of the head-mountable device **100** detecting a user field of view indicating adjustment is needed). Thus, in certain implementations, the head-mountable device **100** includes a motor to auto-drive certain actuation. In this example, the motor can mechanically interface with the connections or adjustment mechanisms to automate or controllably drive the adjustment mechanisms.

[0072] Any of the features, components, and/or parts, including the arrangements and configurations thereof shown in FIGS. **4**A-**4**C 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 FIGS. **4**A-**4**C. Moreover, although not shown, it will be appreciated that more than four of the connection(s) **106** are also contemplated, and the locations of any one the connection(s) **106** described can vary in position and location relative to the figures in which they were described.

[0073] The connection(s) **106** can also allow (or provide) angular or rotational adjustment of the display **102** relative to the facial interface **104**. In accordance with one or more such examples, FIGS. **5**A-**5**C illustrate an example of tilt adjustment via angular adjustment mechanisms **502** (e.g., angular adjustment connections). Via adjustment of the angular adjustment mechanisms **502**, the display **102** can pivot (e.g., rotate) the display **102** up or down by an angular displacement relative to the facial interface **104**, as illustrated in FIGS. **5**A-C.

[0074] In particular, FIG. **5**A shows the angular adjustment mechanisms **502** in a home state (e.g., with no angular tilt). It will be appreciated, however, that alternative home states with angular tilt are herein contemplated.

[0075] FIG. **5**B shows the angular adjustment mechanisms **502** in a negative angular state (e.g., downward angular tilt) relative to the home state. By contrast, FIG. **5**C shows the angular adjustment mechanisms **502** in a positive angular state (e.g., upward angular tilt) relative to the home state.

[0076] As with the depth adjustment mechanisms **402** described above, the angular adjustment mechanisms **502** can also be adjusted in myriad different ways. For example, the angular adjustment mechanisms **502** can be adjusted manually (e.g., via user controls, voice commands, or user gestures). As another example, the head-mountable device **100** can automatically adjust the angular adjustment mechanisms **502** based on a detected user field of view.

[0077] In certain implementations, the angular state can have angular range of negative 7.5 degrees in a fully extended negative angular tilt state, to positive 7.5 degrees in a fully extended positive angular tilt state. The angular state can be discrete (e.g., with limited positional states) or continuous (e.g., unlimited positional states).

[0078] Any of the features, components, and/or parts, including the arrangements and configurations thereof shown in FIGS. **5**A-**5**C 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 FIGS. **5**A-**5**C.

[0079] In some cases, the connection(s) **106** can be statically adjusted, customized, or set. For instance, the connection(s) **106** may be adjusted upon initially donning the head-mountable device **100**, and thereafter the connection(s) **106** is set without the ability to externally modify the connection(s) **106**. That is, the connection(s) **106** nor a corresponding actuator control may be externally accessible when the apparatus is donned (e.g., without some disassembly of the head-mountable device **100**). In accordance with one or more such examples, FIGS. **6**A-**6**B illustrate an example head-mountable device **600** with adjustment connections **602** between the display **102** and the facial interface **104**. In particular, FIG. **6**A shows the head-mountable device assembly, while FIG. **6**B provides a zoomed-in view of one of the adjustment connections **602**.

[0080] The adjustment connections **602** can connectively join the display **102** at a distance from the facial interface **104** (as similarly described above for the connection(s) **106**). The adjustment connections **602** can be positioned in myriad different locations. As shown, however, the adjustment connections **602** are positioned in upper corners of the forehead region and at the zygoma regions.

[0081] Additionally, the adjustment connections **602** as shown include an adjustable pillar **604**. The adjustable pillar **604** is configured to slide into and out of an adjustment connection. Specifically, the adjustable pillar **604** moves relative to a base **603** of the adjustment connection. The adjustable pillar **604** is connected to the facial interface **104**, and the base **603** is connected to the display **102**. Alternatively, opposite configurations are herein contemplated (e.g., the adjustable pillar **604** connected to the display **102** and the base **603** connected to the facial interface **104**). Thus, adjusting the adjustable pillar **604** (in or out of the base **603**) causes a corresponding change in distance between the display **102** and the facial interface **104**. The adjustable pillar **604** further includes holes **606** configured to receive a set screw (or other fastener) by which the adjustable pillar **604** can be positionally affixed upon setting to the desired position.

[0082] The adjustable pillar **604** can include a variety of different specifications (e.g., according to desired load distribution). For example, in some instances, the adjustable pillars **604** are constructed to withstand the compressive force of the strap **103** (not shown) pulling the display **102** towards the facial interface **104**. In certain implementations, the adjustment connections **602** can distribute up to a 6 kN applied load (e.g., from the display **102** along the facial interface **104**).

[0083] Any of the features, components, and/or parts, including the arrangements and configurations thereof shown in FIGS. **6**A-**6**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 FIGS. **6**A-**6**B.

[0084] In contrast to static adjustment, the following description for FIGS. **7**A-**27** discusses various examples of dynamic adjustment (e.g., for different users, head sizes, head shapes, etc.)-where “dynamic” refers to on-the-fly or real time adjustment as may be desired for a given user at a given time. Moreover, as discussed above, the head-mountable device of the present disclosure can include single-point systems with a singular adjustment mechanism. In accordance with one or more examples of the present disclosure, FIGS. **7**A-**7**B show an example head-mountable device **700** including the display **102** and the facial interface **104**. In particular, the head-mountable device **700** includes an angular adjustment connection **702** that movably constrains the display **102** relative to the facial interface **104**.

[0085] The angular adjustment connection **702** specifically includes a linkage **704** attached to the display **102**. The linkage **704** includes notches **706** configured to receive a locking element **708**, where the locking element **708** is connected to the facial interface **104**. The notches **706** correspond to positions at which the locking element **708** can engage the linkage **704** for maintaining a position of the linkage **704**.

[0086] The display **102** can be moved (e.g., rotated) by sliding the linkage **704** relative to the locking element **708**. For example, the linkage **704** allows the display **102** to pivot relative to the facial interface **104** when the linkage **704** extends or the linkage **704** retracts relative to the locking element **708**.

[0087] In certain implementations, the linkage **704** automatically moves in response to direct manipulation of the display **102**. For example, the linkage **704** can extend or retract relative to the locking element **708** in response to user manipulation (e.g., a user hand tilting) of the display **102**.

[0088] Any of the features, components, and/or parts, including the arrangements and configurations thereof shown in FIGS. **7**A-**7**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 FIGS. **7**A-**7**B.

[0089] The head-mountable device of the present disclosure can also include a multi-point system where multiple adjustment mechanisms in combination can allow (or provide) multiple degrees of freedom (e.g., multiple directions of display mobility). In accordance with one or more such examples, FIG. **8** illustrates the display **102** and facial interface **104** connected by adjustable connections **802***a*-**802***d*. The adjustable connections **802***a*-**802***d* are disposed between the display **102** and the facial interface **104**. Each of the adjustable connections **802** can be individually adjusted such that the display and be displaced linearly and/or angularly.

[0090] For example, the adjustable connections **802***a*, **802***b* can be adjusted so the top of the display is a first distance dl from the facial interface. The adjustable connections **802***c*, **802***d* can be adjusted differently than the adjustable connections **802***a*, **802***b* so that the bottom of the display is a second distance d**2** from the facial interface **104**. In downward tilting cases, the second distance d**2** can be less that the first distance d**1**. By contrast, for upward tilting cases, the second distance d**2** can be more than the first distance d**1**. In this way, the adjustable connections **802***a*-**802***d* make the angular adjustment connection between the facial interface **104** and the display **102**, and the adjustable connections **802** make the linear adjustment connection between the facial interface **104** and the display **102**.

[0091] As another example, the adjustable connections **802***a*-**802***d* can be adjusted in other ways. For instance, the adjustable connections **802***a*-**802***d* can be adjusted in a same or similar fashion (e.g., all lengthened or retracted by a same distance) to linearly translate the display **102** towards or away from the facial interface **104**.

[0092] Any of the features, components, and/or parts, including the arrangements and configurations thereof shown in FIG. **8** 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. **8**.

[0093] Where FIGS. **6-8** depict example adjustment mechanisms without actuator controls (moving instead via direct user manipulation or setting of the head-mountable device), the following figures depict adjustment mechanisms with dynamic actuator controls. Indeed, as mentioned above, the connections (i.e., adjustment mechanisms or actuators) of the present disclosure can include adjustment controls configured for myriad different modes of user input and in various locations. In accordance with one or more such embodiments, FIGS. **9**A-**24**B show example adjustment mechanism variations of the head-mountable device **100**. In particular, the head-mountable device **100** includes the display **102**, the facial interface **104**, and the strap **103** (each described above).

[0094] In addition, FIGS. **9**A-**24**B respectively depict front and side-view profiles of head-mountable devices **900-2400** with corresponding connections **902-2402** (which are the same as or similar to the connection(s) **106** also described above). The connections **902-2402** movably constrain the display **102** relative to the facial interface **104**. The connections **902-2402** can therefore include myriad different forms of connections (e.g., mechanical connections) as indicated previously. Further, the connections **902-2402** can include myriad different forms of control mechanisms (e.g., actuator controls) that actuate the connections **902-2402** in response to user input.

[0095] In many examples, the head-mountable devices **900-2400** include actuator controls such as levers (e.g., side peel lever, vertical slide lever, etc.), buttons (push-button, side push button, top push button, automatic release button, etc.), dials (vertical scroll wheel dial, horizontal scroll wheel dial, top scroll wheel dial, etc.), rockers, sliders, or toggles. The actuator controls can be combined with multiple control mechanisms. For example, a sliding actuator controller can include a lever which can be user to lock a head-mountable device in position at the desired viewing state. In another example, a combined actuator control may include a rocker combined with a scroll wheel, such that the scroll wheel, when engaged by the rocker rotates, causing a change in distance between the display **102** and the facial interface **104**. It can be appreciated that a number of variations and examples are contemplated herein, and the examples provided below serve to illustrate a few of the possible configurations.

[0096] FIGS. **9**A-**9**B illustrate a head-mountable device **900** with a connection **902**. The connection **902** includes an actuator control **904**. The actuator control **904** is positioned on a side portion of the display **102** or the facial interface **104**. The actuator control **904** includes a side push button **906**. In response to actuation of the side push button **906** (e.g., an inward push, press, tap), the connection

902 can translate the display **102** to or from a first state **908**, a second state **910**, or a third state **912**. Although FIGS. **9**A-**9**B illustrate discrete states or positions (i.e., the first state **908**, the second state **910**, and the third state **912**), it will be appreciated that head-mountable device **900** can include more or fewer positional states. In certain implementations, the head-mountable device **900** includes a continuous resolution of positional states (as opposed to discrete, predetermined positional states).

[0097] In one or more examples, the side push button **906** can be actuated in various ways. For instance, the side push button **906** can include a push-to-release button, a push-and-hold button, slide-push buttons, top-push buttons, etc.). The buttons can be located in various locations (e.g., top portion, side portion, bottom portion, etc.) of the head-mountable device **900**, either on the display **102** or on the facial interface **104**.

[0098] FIGS. **10**A-**10**B illustrate a head-mountable device **1000** with a connection **1002**. The connection **1002** includes an actuator control **1004**. The actuator control **1004** is similar to the actuator control **904**. In particular, the actuator control **1004** includes a top push button positioned at a top portion of the display **102** or the facial interface **104** (e.g., at one or both top corners of the head-mountable device **1000**). When the actuator control **1004** is pressed, the connection **1002** can translate the display **102** to or from the first state **908**, the second state **910**, or the third state **912**, as described above.

[0099] In another example, the head-mountable device **100** includes actuation components that have actuator controls that slide or twist (e.g., by levers, buttons, rotatable components, etc.) causing the display **102** to move relative to the facial interface **104**. FIGS. **11**A-**14**B illustrate such examples.

[0100] In particular, FIGS. **11**A and **11**B illustrate a head-mountable device **1100** with a connection **1102**. The connection **1102** includes an actuator control **1104**. The actuator control **1104** is positioned on a side portion of the display **102** or the facial interface **104**. The actuator control **1104** includes a side peel lever. The side peel lever of the actuator control **1104**, when pulled downward, releases a lock (e.g., a cam lock) allowing the connection **1102** to move the display **102** relative to the facial interface **104**. Additionally, the actuator control **1104**, when pushed upward into a locked position, causes the connection **1102** to lock the display **102** into position relative to the facial interface **104**.

[0101] FIGS. **12**A and **12**B illustrate a head-mountable device **1200** with a connection **1202**. The connection **1202** includes an actuator control **1204**. The actuator control **1204** is also positioned on a side portion of the display **102** or the facial interface **104**. The actuator control **1204** includes a twist sleeve lever. Thus, the twist sleeve lever of the actuator control **1204** can rotate (e.g., outward in a clockwise direction), allowing the connection **1202** to move the display **102** relative to the facial interface **104**. Likewise, the actuator control **1204** can be rotated in an opposite direction (e.g., inward in a counterclockwise direction), allowing the connection **1202** to positionally fix the display **102** relative to the facial interface **104**.

[0102] FIGS. **13**A and **13**B illustrate a head-mountable device **1300** with a connection **1302**. The connection **1302** includes an actuator control **1304**. The actuator control **1304** is similarly positioned on a side portion of the display **102** or the facial interface **104**. The actuator control **1304** includes a finger pinch slider. The finger pinch slider of the actuator control **1304** can slide frontwards and backwards allowing the connection **1302** to positionally move (or lock) the display **102** relative to the facial interface **104**.

[0103] FIGS. **14**A and **14**B illustrate a head-mountable device **1400** with a connection **1402**. The connection **1402** includes an actuator control **1404**. The actuator control **1404** is positioned on a side portion of the display **102** or the facial interface **104**. The actuator control **1404** includes a sleeve slide. The sleeve slide of the actuator control **1404** can slide along the actuator control **904** allowing the connection **1402** to move the display **102** relative to the facial interface **104**.

[0104] FIGS. **15**A and **15**B illustrate a head-mountable device **1500** with a connection **1502**. The connection **1502** includes an actuator control **1504**. The actuator control **1504** is positioned along an outer periphery of the head-mountable device **1500** (e.g., from top to bottom corners at a side portion of the display **102** or the facial interface **104**). The actuator control **1504** includes a vertical slide that moves approximately up and down along the outer periphery of the head-mountable device **1500**. The vertical slide of the actuator control **1504** can be toggled between positions (e.g., the first state **908**, the second state **910**, and the third state **912**). Additional detail of this embodiment is discussed further below in relation to FIGS. **25**A-**25**D.

[0105] FIGS. **16**A and **16**B illustrate a head-mountable device **1500** with a connection **1602**. The connection **1602** includes an actuator control **1604**. The actuator control **1604** is positioned on a side portion of the display **102** or the facial interface **104**. The actuator control **1604** includes a side temple squeeze button (e.g., spring button) that, when squeezed, allows the connection **1602** to contemporaneously move the display **102** relative to the facial interface **104**. The side temple squeeze button of the actuator control **1604** can automatically release when one of the first state **908**, the second state **910**, or the third state **912** is reached. The side temple squeeze button of the actuator control **1604** can have the button oriented upward (or in alternative cases, downward) relative to the head-mountable device **1600**.

[0106] FIGS. **17**A and **17**B illustrate a head-mountable device **1700** with a connection **1702**. The connection **1702** includes an actuator control **1704**. The actuator control **1704** is positioned on a side portion of the display **102** or the facial interface **104**. The actuator control **1704** includes a scroll wheel rotatable about an axis **1706** proceeding inward and outward of the head-mountable device **1700**. In some examples, the scroll wheel of the actuator control **1704** rotates in response to tangential forces (e.g., a finger swipe from front to back or up and down). In other examples, the scroll wheel of the actuator control **7104** rotates in response to twisting fingers. The scroll wheel of the actuator control **1704**, when rotated about the axis **1706**, can cause the connection **1702** to correspondingly adjust the distance between the display **102** and the facial interface **104**.

[0107] FIGS. **18**A and **18**B illustrate a head-mountable device **1800** with a connection **1802**. The connection **1802** includes an actuator control **1804**. The actuator control **1804** is positioned on a side portion of the display **102** or the facial interface **104**. The actuator control **1804** includes a scroll wheel rotatable about an axis **1806**. The actuator control **1804**, like the actuator control **1704**, can respond to tangential forces (such as a finger swipe up or down). The scroll wheel of the actuator control **1804**, when rotated about the axis **1806**, can cause the connection **1802** to correspondingly adjust the distance between the display **102** relative to the facial interface **104**.

[0108] FIGS. **19**A and **19**B illustrate a head-mountable device **1900** with a connection **1902**. The connection **1902** includes an actuator control **1904**. The actuator control **1904** is positioned on a side portion of the display **102** or the facial interface **104**. The actuator control **1904** is similar to the actuator control **1804**. In particular, the actuator control **1904** includes a scroll wheel rotatable about an axis **1906**. The scroll wheel of the actuator control **1904** can therefore respond to tangential forces (e.g., a finger swipe front to back, and vice-versa). In response to this user interaction, the connection **1902** can move the display **102** relative to the facial interface **104**.

[0109] FIGS. **20**A and **20**B illustrate a head-mountable device **2000** with a connection **2002**. The connection **2002** includes an actuator control **2004**. The actuator control **2004** includes a slider (e.g., toggle) positioned on the top region of the display **102** or the facial interface **104** (e.g., along a forehead region). The actuator control **904** moves laterally (e.g., inward and outward) to correspondingly cause the connection **2002** to adjust the distance between the display **102** relative to the facial interface **104** (e.g., frontwards or backwards).

[0110] FIGS. **21**A and **21**B illustrate a head-mountable device **2100** with a connection **2102**. The connection **2102** includes an actuator control **2104**. The actuator control **2104** includes a rocker positioned on the top region of the display **102** or the facial interface **104**. The actuator control **2104** moves up or down about a pivot **2106**. In response to up/down actuation of the actuator control **2104**, the connection **2102** adjusts the distance between the display **102** relative to the facial interface **104**.

[0111] FIGS. **22**A-**24**B illustrate an actuator control that includes a scroll wheel disposed on top of a head-mountable device. The scroll wheel can be rotated around different axes to adjust the distance between the display **102** relative to the facial interface **104**. Further detail is provided below.

[0112] In particular, FIGS. **22**A and **22**B illustrate a head-mountable device **2200** with a connection **2202**. The connection **2202** includes the actuator control **1804** described above. Here, however, the actuator control **1804** is positioned on a top portion of the display **102** or the facial interface **104**. Indeed, the actuator control **1804** includes a scroll wheel rotatable about an axis **2204**. The scroll wheel of the actuator control **1804**, when rotated up or down about the axis **2204**, causes the connection **2202** to adjust the distance between the display **102** relative to the facial interface **104**.

[0113] FIGS. **23**A and **23**B illustrate a head-mountable device **2300** with a connection **2302**. The connection **2302** also includes the actuator control **1804** described above. Differently though, the actuator control **1804** is positioned on a top portion of the display **102** or the facial interface **104**. The actuator control **1804** also includes a scroll wheel rotatable about an axis **2304**. The scroll wheel of the actuator control **1804**, when rotated up or down about the axis **2304**, causes the connection **2302** to adjust the distance between the display **102** relative to the facial interface **104**.

[0114] FIGS. **24**A and **24**B illustrate a head-mountable device **2400** with a connection **2402**. The connection **2402** includes the actuator control **1704** described above, albeit differently located in FIGS. **24**A-**24**B. In particular, the actuator control **1704** is positioned on a top portion of the display **102** or the facial interface **104**. The actuator control **1704** includes a scroll wheel rotatable about an axis **2404**. The scroll wheel of the actuator control **1704**, when rotated about the axis **2404**, causes the connection **2402** to adjust the distance between the display **102** relative to the facial interface **104**.

[0115] Any of the features, components, and/or parts, including the arrangements and configurations thereof shown in FIGS. **9**A-**24**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 FIGS. **9**A-**24**B.

[0116] As discussed above, a head-mountable device of the present disclosure can include connections (e.g., adjustment mechanisms) that can toggle from position to position via a sliding actuation. In accordance with one or more such examples, FIG. **25**A shows a perspective view of the head-mountable device **1500** shown in FIGS. **15**A and **15**B. The head-mountable device **1500** includes connections **2502***a*, **2502***b* having an actuator control **1504**. The actuator control **1504** includes a handle or lever that juts out from the head-mountable device **1500** for convenient user manipulation of the connections **2502***a*, **2502***b* (e.g., a sliding motion along the periphery of the head-mountable device **1500**).

[0117] As shown, user interaction with the actuator control **1504** can move the connections **2502***a*, **2502***b* in a manner that toggles the connections **2502***a*, **2502***b* between three discrete states (e.g., positions) including the first state **908**, the second state **910**, and the third state **912**. The connections **2502***a*, **2502***b* are independently movable. In other implementations, however, the connections **2502***a*, **2502***b* are movably connected to each other. It will be appreciated that the connections **2502***a*, **2502***b* can move within the head-mountable device **1500** in myriad different ways. In particular examples, the connections **2502***a*, **2502***b* follow a track having a constant radius.

[0118] As the connections **2502***a*, **2502***b* move, the display **102** correspondingly moves relative to the facial interface **104**. The particular movement of the connections **2502***a*, **2502***b* causing the head-mountable device adjustment is described below in relation to FIGS. **25**B-**25**D (depicting the connection **2502***a* in greater detail). In particular, FIG. **25**B illustrates the connection **2502***a* including a stepped adjustment portion **2503** in a first state. In the first state, the facial interface **104** and the display **102** are positioned a distance **2504***a* apart (e.g., about zero mm).

[0119] By contrast, FIG. **25**C illustrates the connection **2502***a* moving left as indicated in the provided arrow. In doing so, the stepped adjustment portion **2503** correspondingly moves in a stepwise fashion, thereby creating increased separation between the display **102** and the facial interface **104** of a distance **2504***b* (e.g., about 3 mm) to a second positional state. Still further, FIG. **25**D illustrates the connection **2502***a* moving further left as indicated in the provided arrow. With this additional movement, the stepped adjustment portion **2503** moves another step to create more separation between the display **102** and the facial interface **104** of a distance **2504***c* (e.g., about 6 mm) to a third positional state. Thus, the geometry or structure of the stepped adjustment portion **2503** can provide a desired stepwise resolution between positional states by causing the display **102** to move away from (or towards) the facial interface **104**.

[0120] Any of the features, components, and/or parts, including the arrangements and configurations thereof shown in FIGS. **25**A-**25**D 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 FIGS. **25**A-**25**D.

[0121] As briefly mentioned above, multiple connections of a head-mountable device can be linked together as a single connection. The links between connections of a head-mountable device form a timing mechanism that causes the connections to move together uniformly. In accordance with one or more such examples, FIGS. **26-27** illustrate respective perspective views of assemblies **2600-2700** for head-mountable devices.

[0122] In particular, FIG. **26** depicts the assembly **2600** for a head-mountable device with a connection **2602** that is movably adjustable via an actuator control **2604**. The actuator control **2604** is positioned along a forehead region, but oriented downward (albeit myriad other orientations are herein contemplated). In response to actuation of the actuator control **2604**, stepped adjustment portions **2606** each move in unison in a stepwise fashion (as similarly described above for the stepped adjustment portion **2503** in relation to FIGS. **25**B-**25**D). Linkage arms **2608** movably connect portions of the connection **2602** to provide such a timing mechanism that transfers motion in a coordinated manner. While FIG. **26** illustrates stepped adjustment portions **2606**, the adjustment portions can have additional steps or even a gradual incline surface that provides a finer adjustment capability.

[0123] In contrast to stepped adjustment portions, FIG. **27** depicts the assembly **2700** for a head-mountable device with a connection **2702** with toggle links. In particular, the connection **2702** is movably adjustable via the actuator control **2604**. In response to actuation of the actuator control **2604**, toggle links **2704** toggle between stowed and locked positions. When the toggle links **2704** move in unison, the display **102** correspondingly moves relative to the facial interface **104**. Moreover, in this configuration, the connection **2702** moves in binary fashion between a first positional state and a second positional state. The linkage arms **2608** in FIG. **27** also movably connect portions of the connection **2702** to provide such a timing mechanism that transfers motion in a coordinated manner.

[0124] Any of the features, components, and/or parts, including the arrangements and configurations thereof shown in FIGS. **26-27** 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 FIGS. **26-27**. The following figure descriptions for FIGS. **28-33** relate to example head-mountable devices, wearable apparatuses, or wearable electronic devices that can implement two degrees of freedom-namely angular tilt and linear translation toward and away from the user's face. In these examples, a linear slide can be implemented with certain structure to control actuation of the linear slide (whether in response to user adjustment or an applied force).

[0125] FIGS. **28-30** illustrate top, front, and side views, respectively, of a head-mountable device **2800** in accordance with one or more examples of the present disclosure. As shown, the head-mountable device **2800** can include a display frame **2802**, a facial interface **2804**, and connections **2806***a*-**2806***d*. The display frame **2802** and associated display can be the same as, or similar to, the display frame **105** (and associated display **102**) discussed above. The facial interface **2804** can be the same as, or similar to, the facial interface **104** discussed above. Likewise, the connections **2806***a*-**2806***d* can be the same as or similar to the connection(s) **106** discussed above.

[0126] In particular, however, the head-mountable device **2800** can include actuators **2808**, **2810**. The actuators **2808**, **2810** can include a variety of different actuators. In particular examples, the actuators **2808**, **2810** include linear actuators of a linear adjustment system (e.g., that facilitate translational movement of the facial interface **2804** toward or away from the display frame **2802**). For instance, the actuators **2808**, **2810** can include linear slides and/or linear springs that can translate in and out to vary a distance (e.g., a depth distance, eye relief, etc.) between the facial interface **2804** and the display frame **2802**. In particular, the actuators **2808** correspond to forehead actuators or top actuators, and the actuators **2810** correspond to zygoma actuators or side actuators. It will be appreciated that additional or alternative configurations of the actuators **2808**, **2810** are herein contemplated. For instance, actuators can be positioned in the cheek (maxilla region) along a bottom portion of the head-mountable device **2800**. Additional details regarding the actuators **2808**, **2810** are described below in relation to FIGS. **31-33**.

[0127] In some examples, the actuators **2808**, **2810** are controlled or manipulated via at least one of actuator controls **2812***a*, **2812***b*. In these or other examples, the actuator controls **2812***a*, **2812***b* can include a variety of different types of controls, such as a lever, button, dial, rocker, slider, or toggle (as described above). The actuator controls **2812***a*, **2812***b* can be engaged via manual manipulation and/or via hands-free or automated methods (also mentioned above). The actuator controls **2812***a*, **2812***b* can be positioned in various locations on or within the head-mountable device **2800**. In particular examples, the actuator controls **2812***a*, **2812***b* can be positioned adjacent to a maxilla region of a human face when the head-mountable device **2800** is donned. Other example positions for the actuator controls **2812***a*, **2812***b* can include the zygoma region, forehead region, on the arms (not shown), or within an interior portion of the optical space adjacent the display.

[0128] In these or other examples, the actuator controls **2812***a*, **2812***b* can control or manipulate the actuators in a variety of ways. In some examples, the actuator controls **2812***a*, **2812***b* are connected to flexible drive shafts **2814**, **2816**. In particular examples, the flexible drive shafts **2814**, **2816** can transfer energy or movement from engagement (e.g., depression) of at least one of the actuator controls **2812***a*, **2812***b* to the actuators **2808**, **2810** (or associated locks, as described below). Examples of the flexible drive shafts **2814**, **2816** can include cables, tensioned wires, rods, dowels, etc. In some examples, the flexible drive shafts **2814**, **2816** are positioned inside the display frame **2802** (hidden from exterior viewing). In other examples, the flexible drive shafts **2814**, **2816** are positioned externally (e.g., on an outside surface of the display frame **2802**).

[0129] In at least some examples, the flexible drive shafts **2814**, **2816** can provide synchronized movement or parallel motion for each of the actuators **2808**, **2810**. For example, the flexible drive shafts **2814**, **2816** can be connected to each other via a linkage **2818**. Examples of the linkage **2818** include a gear system, a pulley system, a pivot connection, etc.

[0130] The flexible drive shafts **2814**, **2816** can be motion-synchronized via the linkage **2818** to mitigate (or prevent) uneven translation between the actuators **2808**, **2810**. Further, in some examples, the linkage **2818** can allow a single input to one of the actuators **2808**, **2810** to control both of the flexible drive shafts **2814**, **2816**. That is, in certain implementations, engagement of both of the actuator controls **2812***a*, **2812***b* is not required to actuate all of the actuators **2808**, **2810** (and/or their corresponding locks, described below).

[0131] Any of the features, components, and/or parts, including the arrangements and configurations thereof shown in FIGS. **28-30** 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 FIGS. **28-30**. The following figure descriptions in relation to FIGS. **31-33** relate to specific examples of the actuators **2808**, **2810** discussed above. Indeed, the actuators **2808**, **2810** can include a linear adjustment connection between the display and the facial interface, where the linear adjustment connection includes a linear slide actuator with a locking mechanism.

[0132] FIGS. **31-33** respectively illustrate a perspective view of lock-slider disengagement, a front view of lock-slider disengagement, and a front view of lock-slider engagement of a portion of a linear adjustment connection **3100** in accordance with one or more examples of the present disclosure. In these or other examples, the linear adjustment connection **3100** includes an actuator **3102** (i.e., a linear slide), an actuator lock **3104** (otherwise referred to as a lock), and an actuator control (e.g., the actuator controls **2812***a*, **2812***b* not shown). As will be discussed below, in response to an actuator control, the actuator lock **3104** can engage the actuator **3102** to hold the actuator **3102** in position, or else to release the actuator **3102** for desired adjustability.

[0133] As shown, the actuator **3102** can be designed to translate in a slide direction **3116** (e.g., to move the facial interface **2804** away from the display frame **2802**). The actuator **3102** can also freely translate in a direction opposite the slide direction **3116** (e.g., to move the facial interface **2804** toward the display frame **2802**) when the actuator lock **3104** is disengaged from the actuator **3102**. To perform this function, the actuator **3102** can include certain structures. For example, the actuator **302** can include teeth **3106** positioned on a top surface **3107**. The teeth **3106** can extend upward from the top surface **3107** for a tooth height **3110**. In some examples, the tooth height **3110** can be tuned based on various design factors. For example, the tooth height **3110** can affect a stack thickness of one or more portions of the display frame **2802**. As another example, the tooth height **3110** can affect an ability of the actuator lock **3104** to deflect upwards in a direction **3122** (e.g., without damage to the actuator lock **3104**). Thus, in some examples, the tooth height **3110** can be minimized or reduced.

[0134] As an additional example, the teeth **3106** can include a tooth pitch (e.g., an amount of teeth per inch defining a distance **3112** between teeth). Like the tooth height **3110**, the tooth pitch can also be tuned based on various design factors. For example, a finer tooth pitch (e.g., a smaller distance **3112** or more teeth per inch) can be utilized as the tooth height **3110** is decreased. Additionally or alternatively, tooth pitch and/or the tooth height **3110** can be tuned for a desired amount of force at which back-drivability can occur (or to entirely prevent back-drivability according to some examples). In these or other examples, the term “back-drive” or “back-drag” refers to translation of the actuator **3102** in a direction opposite the slide direction **3116** (e.g., when the facial interface **2804** and the display frame **2802** move toward each other in response to an applied force from one of the display frame **2802** or the facial interface **2804**).

[0135] In more detail, the teeth **3106** can include leading tips **3114**. The leading tips **3114** can include a lead-in structure where teeth **3108** (and specifically leading tips **3118**) of the actuator lock **3104** can begin to engage. The leading tips **3114**, **3118** can include tapered portions or angled portions of the teeth **3106**, **3108** that serve as ramps (e.g., to avoid dead-band or teeth misalignment/blunt collisions where the actuator lock **3104** is prevented from engaging the actuator

3102). That is, when transitioning from slider-lock disengagement (shown in FIG. **32**) to slider-lock engagement (shown in FIG. **33**), the leading tips **3114**, **3118** allow the teeth **3108** of the actuator lock to smoothly slide into and seat between the teeth **3106** of the actuator **3102**.

[0136] With respect to FIG. **32** specifically, the actuator lock **3104** can translate in a lock translation direction **3120** (e.g., perpendicular to the slide direction **3116**). In particular, the actuator lock **3104** can translate in the lock translation direction **3120** in response to at least one of the actuator controls **2812***a*, **2812***b* being engaged (e.g., depressed) and the flexible drive shafts **2814**, **2816** correspondingly engaging the actuator lock **3104**. Thereafter, the actuator **3102** can be adjusted to translate the facial interface **2804** toward or away from the display frame **2802** (or associated display). Additionally, upon release of the actuator controls **2812***a*, **2812***b*, the actuator lock **3104** can move to an engaged position (shown in FIG. **33**) in which the teeth **3106** and the teeth **3108** are engaged or otherwise positioned adjacent each other. In this position, the actuator **3102** is positionally locked in place to inhibit translation of the facial interface **2804** toward or away from the display frame **2802** (or associated display). As further shown in FIG. **33**, the leading tips **3114** can extend beyond the teeth **3108**, and the leading tips **3118** can extend beyond the teeth **3106**.

[0137] When the teeth **3106**, **3108** are engaged (as shown in FIG. **33**), the actuator lock **3104** can be deflected upward in a lock deflection direction **3122**. The lock deflection direction **3122** can be perpendicular to both the slide direction **3116** and the lock translation direction **3120**. In these or other examples, the actuator lock **3104** can deflect in the lock deflection direction **3122** during a back-driving or back-dragging event in which the actuator **3102** moves opposite the slide direction **3116**. To facilitate this back-driving or back-dragging, the actuator lock **3104** can act as a cantilever spring to deflect in the lock deflection direction **3122** in response to an applied force at the facial interface **2804** or the display frame **2802**. In some examples, actuator lock **3104** can be tuned to deflect in response to a predetermined amount of force (e.g., about 5 Newtons to about 500 Newtons per actuator, about 10 Newtons to about 100 Newtons per actuator, or about 20 Newtons to about 40 Newtons per actuator). In these or other examples, various design factors for the actuator lock **3104**, such as tooth angles or bending stiffness, can be adjusted to provide the desired force tuning.

[0138] Any of the features, components, and/or parts, including the arrangements and configurations thereof shown in FIGS. **31-33** 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 FIGS. **31-33**. The following description provides more detail regarding an example implementation of multiple linear adjustment connections connected to a flexible driveshaft (or multiple flexible drive shafts).

[0139] FIG. **34** illustrates a perspective view of a portion of a head-mountable device **3400** in accordance with one or more examples of the present disclosure. As shown, the head-mountable device **3400** includes multiple actuators (e.g., multiple linear adjustment connections **3100***a*-**3100***d*) discussed above with respect to the linear adjustment connection **3100**. As also mentioned, each linear adjustment connection **3100***a*-**3100***d* can be actuated via the flexible drive shafts **2814**, **2816**. The flexible drive shafts **2814**, **2816** can be motion-synchronized via the linkage **2818** to mitigate (or prevent) uneven translation between each linear adjustment connection **3100***a*-**3100***d*. Further, in some examples, the linkage **2818** can allow a single input (e.g., a single button press) to actuate each of the linear adjustment connections **3100***a*-**3100***d*. The following description of FIG. **34** gives an example implementation in which this can be performed.

[0140] As shown in FIG. **34**, the head-mountable device **3400** can include actuator controls **3401***a*, **3401***b* (which can be the same as or similar to the actuator controls **2812***a*, **2812***b* discussed above).

In response to a force **3402***a* applied to the actuator control **3401***a*, the lock **3104***a* can correspondingly deflect, translate, or otherwise move to release the slide **3102***a* of the linear adjustment connection **3100***a*. In addition, the flexible drive shaft **2816** can be attached to a joint **3404** (e.g., a ball joint) connected to the lock **3104***a*. As the lock **3104***a* deflects, translates, or otherwise moves in response to the applied force **3402***a*, the flexible drive shaft **2816** can be tensioned or pulled in a direction **3406**.

[0141] The flexible drive shaft **2816** can be attached to a gear anchor **3410** such that, upon pulling of the flexible drive shaft **2816** in the direction **3406**, a first gear **3409***a* connected to the gear anchor **3410** rotates in a direction **3412**. In turn, the lock **3104***b* (which is movably attached to the first gear **3409**) is pulled back away from the slide **3102***b* of the linear adjustment connection **3100***b* as the first gear **3409** rotates in the direction **3412**.

[0142] Furthermore, rotation of the first gear **3409***a* in the direction **3412** can simultaneously induce rotation of the second gear **3409***b* in a direction **3414**. The rotation of the second gear **3409***b* in the direction **3414** can cause the lock **3104***c* (which is movably attached to the second gear **3409***b*) to pull back away from the slide **3102***c* of the linear adjustment connection **3100***c*.

[0143] In addition, rotation of the second gear **3409***b* in the direction **3414** can cause a gear anchor **3416** connected to the second gear **3409***b* to push the flexible drive shaft **2814**. Specifically, the flexible drive shaft **2814** can be connected to the gear anchor **3416** such that, upon rotation of the second gear **3409***b* in the direction **3414**, the flexible drive shaft **2814** is pushed in a direction **3408**. Pushing of the flexible drive shaft **2814** can cause the lock **3104***d* to release from the slide **3102***d* of the linear adjustment connection **3100***d*. For instance, the flexible drive shaft **2814** can be connected to the lock **3104***d* in a same or similar manner as the flexible drive shaft **2816** is attached to the lock **3104***a* to impart slide-lock disengagement.

[0144] Additionally or alternatively, it will be appreciated that a force **3402***b* can be applied to the actuator control **3401***b*, which is in mechanical communication with the lock **3104***d* (in a same or similar manner as the actuator control **3401***a* is mechanically coupled to the lock **3104***a*). Thus, dual inputs via both of the actuator controls **3401***a*, **3401***b* can be applied, but are not required, for synchronized actuation of each of the linear adjustment connections **3100***a*-**3100***d*. Alternatively, the applied force **3402***b* alone (i.e., without the applied force **3402***a*) can be used to actuate each of the linear adjustment connections **3100***a*-**3100***d*.

[0145] Further, in some examples, additional or alternative modes of actuating the linear adjustment connections **3100***a*-**3100***d* can be implemented. For example, solenoids or small motors can be utilized to actuate linear adjustment connections **3100***a*-**3100***d* (with or without the flexible drive shafts **2814**, **2816**). Similarly, in some examples, the actuator controls **3401***a*, **3401***b* can include alternative types of actuator controls. For example, the actuator controls **3401***a*, **3401***b* can be arch sliders that move in an arc path (e.g., along a display frame not shown of the head-mountable display **3400**). The arch sliders can be connected to the flexible drive shafts **2814**, **2816** as discussed above to actuate the linear adjustment connections **3100***a*-**3100***d*.

[0146] Any of the features, components, and/or parts, including the arrangements and configurations thereof shown in FIG. **34** 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. **34**.

[0147] In some examples, a personally customized experience can be provided if the systems and methods detailed herein capture, store, access, and/or transmit personal information data. While the present systems and methods can be performed without such personal information data, if personal information data is used, it should be used in accordance with well accepted and established procedures and protocols that are expressly intended to protect the personal information data from unauthorized access or use. In some instances, the personal information data can be anonymized to further protect the data.

[0148] The foregoing description used specific nomenclature to provide a thorough understanding and explanation of the described embodiments. However, the specific details are not required in order to practice or perform the described examples. Rather, the foregoing descriptions of the specific examples described herein are provided for illustration and description, and are not intended to be exhaustive or to limit the embodiments to the precise forms disclosed. Furthermore, many modifications and variations are possible in view of the above teachings.

Claims

1. A wearable electronic device, comprising: a display; a facial interface; an angular adjustment connection between the display and the facial interface; and a linear adjustment connection between the display and the facial interface, the linear adjustment connection comprising: a first connection; and a second connection joined to the first connection.

2. The wearable electronic device of claim 1, wherein the angular adjustment connection comprises a linkage positioned at a forehead region.

3. The wearable electronic device of claim 1, wherein the first connection is positioned at a forehead region and the second connection is positioned at a zygoma region or a maxilla region.

4. The wearable electronic device of claim 1, wherein the angular adjustment connection and the linear adjustment connection comprise adjustable pillars.

5. The wearable electronic device of claim 4, wherein the adjustable pillars are positioned in a forehead region, a zygoma region, or a maxilla region when the wearable electronic device is donned.

6. The wearable electronic device of claim 1, further comprising a timing mechanism mechanically joining the first connection and the second connection.

7. A wearable electronic device, comprising: a display; a facial interface; an angular adjustment connection between the display and the facial interface; and a linear adjustment connection coupled directly to the angular adjustment connection between the display and the facial interface, the linear adjustment connection comprising: an actuator; an actuator lock engageable with the actuator; and an actuator control connected to the actuator lock.

8. The wearable electronic device of claim 7, wherein the actuator comprises a side slide and a top slide.

9. The wearable electronic device of claim 7, wherein the actuator control comprises a button.

10. The wearable electronic device of claim 7, wherein upon depressing the actuator control: the actuator lock is disengaged from the actuator; and the actuator is adjustable to translate the facial interface toward or away from the display.

11. The wearable electronic device of claim 10, wherein upon releasing the actuator control: the actuator lock is engaged with the actuator; and the actuator is positionally locked in place to inhibit translation of the facial interface toward or away from the display.

12. A wearable apparatus, comprising: a head-mountable display; a facial interface; a connection movably constraining the head-mountable display relative to the facial interface in a first degree of freedom and a second degree of freedom; and an actuator control configured to be adjacent to a maxilla region when the wearable apparatus is donned.

13. The wearable apparatus of claim 12, wherein the connection comprises a linear slide.

14. The wearable apparatus of claim 13, wherein the linear slide is back-drivable.

15. The wearable apparatus of claim 13, further comprising a lock engageable with the linear slide.

16. The wearable apparatus of claim 15, wherein: the linear slide comprises a first set of teeth; and the lock comprises a second set of teeth engageable with the first set of teeth.

17. The wearable apparatus of claim 16, wherein: the first set of teeth comprise first leading tips;

and the second set of teeth comprise second leading tips.

18. The wearable apparatus of claim 17, wherein when the first set of teeth and the second set of teeth are engaged: the second leading tips protrude past the first set of teeth; and the first leading tips protrude past the second set of teeth.

19. The wearable apparatus of claim 15, wherein the actuator control is configured to engage and disengage the lock and the linear slide.

20. The wearable apparatus of claim 19, wherein the actuator control is connected to the lock via a flexible drive shaft.