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Modular omnidirectional actuated floors providing an interactive user experience

Abstract

An interactive user experience system is disclosed. The system includes a processor, a display in electrical communication with the processor and configured to display a visual content of interactive content, a modular tile floor in electrical communication with the processor and including a plurality of tiles configured to move independently to induce or respond to a desired motion for a user in contact with the modular tile floor, a sensor in electrical communication with the processor. The sensor detects at least one of an orientation or a position of the user on the modular tile floor, and based on the detected orientation or position of the user, the processor modifies at least one of the visual content or a movement of the plurality of tiles.

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Background/Summary

FIELD
(1) The present application relates to systems and methods of simulating movement corresponding to interactive content to provide an immersive user experience.

BACKGROUND

(2) Various gaming or simulated experiences attempt to provide immersive experiences to consumers. Current immersive experiences include gaming devices, simulation systems, or amusement rides. However, the experiences often fail to effectively simulate the entirety of the experience. For example, many experiences do not allow users to move during interaction with the device limiting engagement with the experience. For simulated experiences that do allow a user to move during the experience, the movement is often limited to a predefined set of movements. The predefined movements may be unnatural or may make a user aware of the boundaries of the system and limit user engagement or enjoyment with the experience.

(3) Accordingly, there is a need for a system providing an immersive experience and allowing a user to move naturally or in unique ways during the experience.

BRIEF SUMMARY

(4) In one example, an interactive user experience system includes a processor, a display in electrical communication with the processor and configured to display a visual content of interactive content, a modular tile floor in electrical communication with the processor and including a plurality of tiles configured to move independently to induce or respond to a desired motion for a user in contact with the modular tile floor, a sensor in electrical communication with the processor, wherein the sensor detects at least one of an orientation or a position of the user on the modular tile floor, and based on the detected orientation or position of the user, the processor modifies at least one of the visual content or a movement of the plurality of tiles.

(5) In some examples, the display is one or more of a wearable display, a projector, or an electronic screen.

(6) In some examples, the visual content is displayed on the modular tile floor by the projector.

(7) In some examples, the visual content depicts a simulated environment, and the sensor detects movement from the user as feedback corresponding to the interactive content.

(8) In some examples, the movement of the plurality of tiles changes the position of the user corresponding to the feedback.

(9) In some examples, the system further includes an elevating system, wherein a first set of tiles are raised or lowered by the elevating system to define a difference in elevation relative to a second set of tiles and the difference in elevation corresponds to the visual content.

(10) In some examples, the visual content is correspondingly updated in response to one or more of a change in the position of the user, a change in the orientation of the user, or a motion of the user.

(11) In some examples, the sensor is one or more of a light ranging and detection system, a plurality of cameras, or a wearable motion capture device.

(12) In some examples, the sensor determines a position of the user relative to the modular tile floor, and the desired motion prevents the user from crossing a boundary of the modular tile floor.

(13) In some examples, the system further includes an input device, the input device in communication with one or more processors or the modular tile floor and corresponding to the interactive content, and the input device receives an input from the user and provides feedback to the user.

(14) In some examples, the input device receives a second input from a second user different from the user, the second input providing feedback to the user.

(15) In some examples, the movement of the plurality of tiles is correspondingly updated in response to one or more of a change in the position of the user, a change in the orientation of the user, a motion of the user, or a change in the visual content.

(16) In some examples, the sensor determines a gesture of the user, the gesture defining an input to the visual content.

(17) In some examples, the system further includes an object positioned on the modular tile floor, the position of the object controlled by the modular tile floor responsive to a position of the user or corresponding to the visual content

(18) In one example, a method for providing an interactive user experience with a modular tile floor includes determining a simulated experience from interactive content, displaying visual content to a user corresponding to the interactive content, determining a current orientation of the user relative to the modular tile floor by a sensor, and manipulating a position of the user by the modular tile floor responsive to the simulated experience and the current orientation of the user.
(19) In some examples, the method further includes determining an action of the user by the sensor, and providing feedback to the user by the modular tile floor corresponding to the action and the interactive content.
(20) In some examples, the method further includes determining an action of the user by the sensor, and updating the visual content corresponding to the action and the interactive content.
(21) In some examples, the method further includes receiving an input from the user by a user device, and providing feedback to the user corresponding to the input and the interactive content.
(22) In some examples, the method further includes receiving an input from a third party, different from the user, and providing feedback to the user corresponding to the input and the interactive content.
(23) In some examples, the method further includes manipulating a position of an object or objects on the modular tile floor.

Description

BRIEF DESCRIPTION OF THE DRAWINGS
(1) FIG. **1** illustrates an example motion system including a modular floor formed with a plurality of active tiles.
(2) FIG. **2** illustrates an example disk assembly for use in a motion system of the present disclosure.
(3) FIG. **3** illustrates an exploded view of the disk assembly of FIG. **2**.
(4) FIGS. **4**A-**4**D illustrate various orientations of a tilted contact disk of the disk assembly of FIG. **2** that define respective directions a supported object is moved by the disk assembly.
(5) FIG. **5** illustrates a portion of an active tile including an array of disk assemblies.
(6) FIG. **6** illustrates an example computing system for implementing various examples of the present disclosure.
(7) FIG. **7** illustrates a perspective view of an example system including a modular floor providing an interactive user experience.
(8) FIG. **8** illustrates an example system providing an interactive user experience and including two users.
(9) FIG. **9** illustrates an example of the system in which the user controls the movement of an object.
(10) FIG. **10** illustrates an example of the system including more than one groupings of active tiles.
(11) FIG. **11** illustrates a flow chart providing an example method of using the system.
DETAILED DESCRIPTION
(12) The system described herein may include a modular tile floor including a plurality of active tiles associated with interactive content to provide an interactive user experience. The active tiles may move or orient various objects or a user on the floor. For example, a user may walk, jump, or otherwise move on the modular tile floor. The movement of the active tiles may correspond to the interactive content, such as visual portions of the interactive content.
(13) The system may include one or more displays to provide visual content or portions of the interactive content to the user. The display may be on a screen or screens, or an image projected onto the modular tile floor. For example, a projector may be arranged to generate an image on the modular floor. The system may include one or more sensors to determine a position of the user

relative to the modular floor. In some examples, additional objects or users may be on the modular floor and similarly tracked by the sensors. In some examples, the system may provide an input device to the user for inputs to the system corresponding to the interactive content.

(14) In operation, the system may create an immersive experience for the user corresponding to the interactive content. The display or projector may provide visual content corresponding to a simulated world or virtual environment. The interactive content may be in communication with the modular floor to provide the user with simulated feedback corresponding to the interactive content. For example, the modular floor may move or arrange a user in a manner corresponding to the interactive content. The various sensors may detect the movements or the position of the user as an input to the interactive content. For example, the sensors may detect the user move (e.g. walk, run, jump, etc.) in a first direction and cause the modular floor to move in an opposite or different direction to prevent the user from moving relative to the modular floor to maintain the user's position on the modular floor. In some examples, images displayed on the modular floor add to the immersive experience, such as displaying a portion of the visual content (e.g. pathway, location, icons, etc.) to the user. Additional objects or user may be placed on the modular floor to provide interactive experiences between the interactive content and the tangible world.

(15) Turning to the figures, FIG. **1** illustrates an example motion system **100** including a modular floor **102** formed with a plurality of active tiles **104**. The tiles **104** may be of the same or similar shape, such that multiple tiles **104** may be connected together to form the modular floor **102**. For example, the tiles **104** may include a polygonal shape that allows multiple tiles **104** to be connected together to form an integrated surface of the modular floor **102**. The polygonal shape may be any closed plane figure bounded by three or more line segments, such as three line segments defining a triangular shape, four line segments defining a quadrilateral shape, or more than four line segments defining another polygonal shape (e.g., six line segments defining a hexagonal shape, among other suitable shapes). In such examples, any number of tiles **104** may be connected together to define the modular floor **102** of a desired size and shape. The various tiles **104** may be coupled together such as by interlocking or coupling features, or a mounting frame **134** that may secure or hold the tiles **104** in place. The tiles **104** may be positioned adjacent one another to define the modular floor **102**.

(16) As described herein, the motion system **100** may provide or facilitate motion of one or more objects **110** on the modular floor **102**. For instance, the motion system **100** may move one or more objects **110** across the modular floor **102**, such as from a first location to a second location on the modular floor **102**. Additionally, or alternatively, the motion system **100** may allow one or more user participants **114** to move across the modular floor **102** or walk/run on the modular floor **102**, such as part of an exercise program, a gaming system, a control system, or the like. Such examples are non-limiting, and the modular floor **102** may provide or facilitate motion of any object positioned at least partially on the modular floor **102**. For example, in some embodiments, the modular floor **102** may provide or facilitate motion of ride vehicles, gaming objects, containers, or any other object placed or positioned on the modular floor **102**.

(17) In one example, the modular floor **102** may be operated to allow a user participant **114** to walk or run under the user's own power. In such examples, a set of tiles **104** (or at least components of the set of tiles **104**) associated with the present location and a predicted travel path **120** of the user participant **114** may be operated concurrently and in a like manner to move in another direction **122**, such as opposite the current or predicted travel path **120**. In this manner, the motion system **100** may control a position of the user participant **114** on the modular floor **102** (e.g., maintained at a specific location), even while the user participant **114** is walking or running, such as to limit the user participant **114** from walking off the modular floor **102** and/or to avoid a collision with another object **110** or user participant **114** on the modular floor **102**. The motion **122** imparted to the user participant **114** may slow the movement of the user participant **114** relative to the modular floor **102** (e.g., the user participant **114** moves at a rate that is slower than the user's walking/running

pace), halt the relative motion (e.g., the user participant **114** effectively walks/runs in place), or increase the relative motion (e.g., the user participant **114** moves at a rate that is faster than the user's walking/running pace).

(18) In one example, the motion system **100** may be used to support independent movement of multiple (e.g., two or more) user participants **114**. For instance, as shown, the motion system **100** may support a first user participant **114**A moving (e.g., walking, running, etc.) along a first travel path **120**A, and a second user participant **114**B moving (e.g., walking, running, etc.) along a second travel path **120**B that differs from the first travel path **120**A. In such examples, the motion system **100** may impart respective motion **122**A, **122**B on the first and second user participants **114**A, **114**B, such as in a manner as described above. The motions **122**A, **122**B imparted to the user participants **114**A, **114**B may be independent and concurrent, even while different in the example illustrated. In some examples, the modular floor **102** may be configured to move or facilitate movement of an object **110** or user participant **114** in any direction (e.g., any lateral direction across the modular floor **102**), such that the modular floor **102** may be considered an omnidirectional actuated floor.

(19) The motion control described herein may be provided by one or more disk assemblies **130** of the motion system **100**. As shown, the tiles **104** may include one or more disk assemblies **130**, such as a plurality of disk assemblies **130**. In such examples, the disk assemblies **130** may support the one or more objects **110** or user participants **114** on the modular floor **102**. The disk assemblies **130** may be operated to move the objects **110**/user participants **114** on the modular floor **102**, such as in a manner as described herein. For example, the disk assemblies **130** may engage the objects **110**/user participants **114** so as to move the objects **110**/user participants **114** as the disk assemblies **130** are operated, as described herein.

(20) FIG. **2** illustrates an example disk assembly **130** for use in a system of the present description (e.g., motion system **100**, described above), such as with a plurality of other disk assemblies **130** in an active tile **104**. FIG. **3** illustrates an exploded view of the disk assembly **130**. The disk assembly **130** may include a contact disk **202**. The contact disk **202** may be at a first end **204** (e.g., an outer or exposed end) of the disk assembly **130** and includes an upper surface **206**. In one example, the upper surface **206** may be used in the modular floor **102** described herein, such as with a plurality of other surfaces to support and move an object **110**. The contact disk **202** may be positioned and/or supported in the disk assembly **130** so as to place the upper surface **206** at a tilt angle θ, such as relative to the plane **208** of the active tile **104**. In one example, the upper surface **206** may include a contact surface **210** defined by a raised segment or edge relative to the rest of the upper surface **206**. In such examples, the contact surface **210** (along with similar segments/portions of other contact disks in an active tile **104**) may contact and support an object placed on the disk assembly **130**. The tilt angle θ may be an angle of 5 to 60 degrees, with about 8 to 15 degrees being useful in some examples, and about 10 degrees (e.g., 9.5 to 10.5 degrees) being useful in one implementation.

(21) During use, the contact disk **202** may be rotated about a rotation axis **218**, such as shown by arrows **220**. As shown, the rotation axis **218** extends at a non-orthogonal angle to the plane of the upper surface **206**. In this manner, the contact surface **210** of the contact disk **202** may be positioned at a predefined location relative to the rotation axis **218** during operation of the disk assembly **130**, such as to move a supported object in a desired direction, as described herein. For example, the disk assembly **130** may include a swashplate **226** provided with an angled or tilted surface **228** to support the contact disk **202** at the tilt angle θ. The swashplate **226** may be drivable to selectively change where the contact surface **210** is located relative to the rotation axis **218**. For instance, the swashplate **226** may be drivable via outer teeth **230** as shown in FIG. **2**, be belt driven, or the like. In such examples, selective positioning of the contact surface **210** via rotation of the swashplate **226** may control which direction a supported object is moved. In one example, the swashplate **226** may remain stationary or fixed in place relative to the rotation axis **218** during the

rotation **220** of the contact disk **202**.

(22) The disk assembly **130** may include various drive components and bearings to support or facilitate rotation of the contact disk **202** under load. For example, the disk assembly **130** may include a gear **240** for rotating the contact disk **202** about the rotation axis **218**, as detailed herein. A first thrust bearing **242** may be positioned between the contact disc and the swashplate **226**, such as to reduce friction between the contact disc and the swashplate **226**. A second thrust bearing **244** may be positioned between the swashplate **226** and the gear **240**, such as to reduce friction between the swashplate **226** and the gear **240**. The first and second thrust bearings **242**, **244** may be configured to transfer a load on the contact disk **202** downward into the disk assembly **130** (e.g., into the stack of components of the disk assembly **130**). For instance, the first thrust bearing **242** may transfer a downward load from the contact disk **202** onto the swashplate **226**, and the second thrust bearing **244** may transfer the downward load from the swashplate **226** onto the gear **240**. In some examples, the disk assembly **130** may include a top bearing **250** and a bottom bearing **252**, such as for the purposes described below. A fastener **256** may secure the components of the disk assembly **130** together as an operable unit.

(23) Referring to FIG. **3**, the disk assembly **130** may include a drive shaft **310**. The drive shaft **310** may be coupled to the contact disk **202** and driven by the gear **240**. For instance, the disk assembly **130** may include a U-joint **312** pivotally coupled to both an end **318** of the drive shaft **310** and an underside **320** of the contact disk **202**. The U-joint **312** may allow the contact disk **202** to be rotated while the high-point or contact surface **210** of the contact disk **202** is turned or redirected via the swashplate **226** to change the tilt direction or disk orientation of the contact disk **202** (e.g., to change the location of the contact surface **210** relative to the rotation axis **218**). The drive shaft **310** may be coupled to the gear **240** (e.g., via a keyed engagement **324**) such that rotation of the gear **240** rotates the drive shaft **310**. In such examples, rotation of the gear **240** causes the drive shaft **310** to rotate, which, in turn, causes the contact disk **202** to rotate about the rotation axis **218**. With continued reference to FIG. **3**, the top and bottom bearings **250**, **252** may rotationally support the drive shaft **310**, such as centering the drive shaft **310** within the disk assembly **130**.

(24) According to various examples described herein, the contact disk **202** is supported at the tilt angle θ by the tilted surface **228** of the swashplate **226** and then selectively rotated **220** about the rotation axis **218** while the swashplate **226** remains stationary, such as to move an object supported upon the contact surface **210** of the upper surface **206**. Rotation **220** may be provided through a disk rotation mechanism (which includes at least the gear **240**) in the disk assembly **130** that works in combination with a drive system (not shown in FIGS. **2-3**) (e.g., one or more motors driving belts, screw drives, gears, or the like to impart motion on one or more components of the disk rotation mechanism such as upon the outer teeth **230** of the gear **240**).

(25) The upper surface **206** is circular in shape in the illustrated embodiment, with the contact surface **210** being an outer ring-shaped surface or lip configured to engage surfaces of a supported object. The contact disk **202** is positioned or supported at the disk or tilt angle θ (e.g., an angle in the range of 5 to 60 degrees or the like as measured between a horizontal plane and the upper surface **206** of the contact disk **202**). Such configurations cause a raised edge or portion of the contact surface **210** to contact and move an object (e.g., a person, a ride vehicle, a container, or any other object) supported upon the contact disk **202**. The raised edge/segment may be a fraction of the contact surface **210**, such as in the range of 1/10 to ⅖ of the available surface, depending on the magnitude of the tilt angle θ.

(26) The disk assemblies **130** may be adapted for the contact disk **202** to be oriented as desired to set the location of the contact surface **210** relative to the rotation axis **218**. For instance, the contact disk **202** may be rotated relative to the rotation axis **218**, such as by rotation of the swashplate **226** about the rotation axis **218**, to orient the contact disk **202** relative to the rotation axis **218**, as described above. In such examples, the orientation of the contact surface **210** relative to the rotation axis **218** may define the direction a supported object is moved by the disk assembly **130**.

(27) For example, FIGS. **4**A-**4**D illustrate various orientations of the contact disk **202** that define respective directions a supported object is moved by the disk assembly **130**. Referring to FIG. **4**A, the tilt direction or disk orientation of the contact disk **202** may be set with the contact surface **210** at the "top" of the contact disk **202** (when looking at the page containing FIG. **4**A). If the contact disk **202** is rotated clockwise about the rotation axis **218**, a supported object may be moved in a positive X direction or to the right when looking at the page containing FIG. **4**A. Conversely, if the contact disk **202** is rotated counterclockwise about the rotation axis **218**, the supported object may be moved in a negative X direction or the left when looking at the page containing FIG. **4**A.
(28) Referring to FIG. **4**B, the tilt direction or disk orientation of the contact disk **202** may be set with the contact surface **210** at the "right" of the contact disk **202** (when looking at the page containing FIG. **4**B). If the contact disk **202** is rotated clockwise about the rotation axis **218**, a supported object may be moved in a negative Y direction or downwards when looking at the page containing FIG. **4**B. Conversely, if the contact disk **202** is rotated counterclockwise about the rotation axis **218**, the supported object may be moved in a positive Y direction or upwards when looking at the page containing FIG. **4**B.
(29) Referring to FIG. **4**C, the tilt direction or disk orientation of the contact disk **202** may be set with the contact surface **210** at the "bottom" of the contact disk **202** (when looking at the page containing FIG. **4**C). If the contact disk **202** is rotated clockwise about the rotation axis **218**, a supported object may be moved in a negative X direction or to the left when looking at the page containing FIG. **4**C. Conversely, if the contact disk **202** is rotated counterclockwise about the rotation axis **218**, the supported object may be moved in a positive X direction or the right when looking at the page containing FIG. **4**C.
(30) Referring to FIG. **4**D, the tilt direction or disk orientation of the contact disk **202** may be set with the contact surface **210** at the "left" of the contact disk **202** (when looking at the page containing FIG. **4**D). If the contact disk **202** is rotated clockwise about the rotation axis **218**, a supported object may be moved in a positive Y direction or upwards when looking at the page containing FIG. **4**D. Conversely, if the contact disk **202** is rotated counterclockwise about the rotation axis **218**, the supported object may be moved in a negative Y direction or downwards when looking at the page containing FIG. **4**D.
(31) During any particular operation period used to move an object in a particular direction, the components of the disk assembly **130** may be configured for the contact disk **202** to be oriented in any of the four orientations or disk directions illustrated in FIGS. **4**A-**4**D (or to any intermediate position between these four orientations) and for the contact disk **202** to be concurrently rotated at a desired rate or speed about the rotation axis **218**, while remaining at the tilt angle θ at the particular disk face orientation/direction. As a result, the disk assemblies **130** may move an object **110** or user participant **114** along (or allow a user participant **114** to walk/run in) any direction across the modular floor **102**. In this manner, the disk assemblies **130** may define an omnidirectional actuated floor.
(32) Arrays or pluralities of the disk assemblies **130** may be combined into a single tile **104**, and multiple tiles **104** may be combined to provide the modular floor **102** described herein, or can be used in combination to provide a large floor or platform to move supported objects **110**. In such embodiments, the drive assemblies may be driven independently; however, it may be useful in some embodiments to concurrently drive an array or subset of the disk assemblies **130** used to make up a support floor/platform, such as by orienting and driving/rotating the contact disks **202** in an active tile **104** similarly (e.g., drive the drive assemblies in an active tile **104** concurrently and similarly to move an object on the tile **104** in a particular direction and at a particular speed).
(33) Accordingly, FIG. **5** illustrates a portion of an active tile **104** including an array or plurality of disk assemblies **130**. Referring to FIG. **5**, an array or plurality of disk assemblies **130** may be arranged in a pattern. For example, multiple disk assemblies **130** may be arranged in a rectangular pattern of parallel rows and columns, although other configurations are contemplated. The disk

assemblies **130** may include parallel rotation axes **218** with the upper surfaces **206** facing a single direction. For example, the contact disks **202** may be oriented to have the same disk direction or to have its tilt angle oriented in the same way. The disk assemblies **130** may be driven together as a set or concurrently to rotate at the same rate and in the same direction about their rotation axes **218**. In this manner, the plurality of disk assemblies **130** (or a subset of the disk assemblies **130**) may move an object supported thereon in the same direction and at the same rate.

(34) In the embodiment shown in FIG. **5**, first lead screws **504** are positioned to contact the outer teeth **230** of the swashplates **226**, and second lead screws **506** are positioned to contact the geared/toothed outer surface of the gears **240**. One or more drive motors **510** may be selectively controlled to rotate **512** the first lead screws **504** as needed/desired to set the tilt direction or disk orientation of the contact disks **202** (e.g., to orient the contact disks **202** by rotating the swashplates **226** about their respective rotation axis **218**), such as to position raised edges of the contact disks **202** concurrently in a desired location. Stated differently, rotation of the first lead screws **504** by the drive motors may cause the swashplates **226** to rotate about their respective rotation axes **218**, which, in turn, causes the supported contact disks **202** to likewise rotate to position the contact surfaces **210** at a new location.

(35) Concurrently or at a different time, one or more spin motors **520** may be selectively controlled to rotate the second lead screws **506**, thereby driving the gears **240** to rotate (e.g., at the same rate). Rotation of the gears **240** may cause the contact disks **202** to rotate, with the direction of rotation of the contact disks **202** set by a direction of rotation **522** of the second lead screws **506**. Similarly, the rate of rotation of the contact disks **202** may be set by the rate of rotation **522** of the second lead screws **506**.

(36) Such examples are illustrative only, and the modular floor **102** may be operated using other systems and configurations. For instance, the contact disks **202** may be rotated via intermeshing gears, among other examples. In some examples, one or more (e.g., each) contact disks **202** may be rotated via a gear train including multiple gears. In such examples, one or more motors (e.g., spin motors **510** and/or **520**) may be selectively controlled to rotate the gears, thereby causing the contact disks **202** to rotate.

(37) The embodiments illustrated in FIGS. **1-5** are non-limiting examples for providing a motion system including a modular floor formed with a plurality of active tiles, the active tiles having one or more disk assemblies with a rotatable, angled disk and with mechanisms for rotating/spinning the disk and for orienting the disk to have its raised edge/portion in a desired location to direct a supported object in a desired direction during disk rotation. Thus, the motion system **100**, modular floor **102**, active tiles **104**, and disk assemblies **130**, described above, are illustrative only, and other configurations are contemplated. In one example, the systems and elements described herein (e.g., the tiles **104** and disk assemblies **130**) may be similar to those described in U.S. patent application Ser. No. 15/790,124, now U.S. Pat. No. 10,416,754 B2, and U.S. patent application Ser. No. 16/135,952, now U.S. Pat. No. 10,732,197 B2, the disclosures of which are hereby incorporated by reference for all purposes.

(38) FIG. **6** illustrates an example computing system **600** for implementing various examples described herein. For example, in various embodiments, components of the motion system **100** or other systems described herein may be implemented by one or several computing systems **600**. This disclosure contemplates any suitable number of computing systems **600**. For example, the computing system **600** may be a server, a desktop computing system, a mainframe, a mesh of computing systems, a laptop or notebook computing system, a tablet computing system, an embedded computer system, a system-on-chip, a single-board computing system, or a combination of two or more of these. Where appropriate, the computing system **600** may include one or more computing systems; be unitary or distributed; span multiple locations; span multiple machines; span multiple data centers; or reside in a cloud, which may include one or more cloud components in one or more networks.

(39) Computing system **600** includes a bus **610** (e.g., an address bus and a data bus) or other communication mechanism for communicating information, which interconnects subsystems and devices, such as processor **608**, memory **602** (e.g., RAM), static storage **604** (e.g., ROM), dynamic storage **606** (e.g., magnetic or optical), communications interface **616** (e.g., modem, Ethernet card, a network interface controller (NIC) or network adapter for communicating with an Ethernet or other wire-based network, a wireless NIC (WNIC) or wireless adapter for communicating with a wireless network, such as a WI-FI network), input/output (I/O) interface **620** (e.g., keyboard, keypad, mouse, microphone). In particular embodiments, the computing system **600** may include one or more of any such components.
(40) In particular embodiments, processor **608** includes hardware for executing instructions, such as those making up a computer program. For example, a processor **608** may execute instructions for various components of the motion system **100** or other systems described herein. The processor **608** circuitry includes circuitry for performing various processing functions, such as executing specific software to perform specific calculations or tasks. In particular embodiments, I/O interface **620** includes hardware, software, or both, providing one or more interfaces for communication between computing system **600** and one or more I/O devices. Computing system **600** may include one or more of these I/O devices, where appropriate. One or more of these I/O devices may enable communication between a person and computing system **600**.
(41) In particular embodiments, the communications interface **616** includes hardware, software, or both providing one or more interfaces for communication (such as, for example, packet-based communication) between computing system **600** and one or more other computer systems or one or more networks. One or more memory buses (which may include an address bus and a data bus) may couple processor **608** to memory **602**. Bus **610** may include one or more memory buses, as described below. In particular embodiments, one or more memory management units (MMUs) reside between processor **608** and memory **602** and facilitate accesses to memory **602** requested by processor **608**. In particular embodiments, bus **610** includes hardware, software, or both coupling components of computing system **600** to one another.
(42) According to particular embodiments, computing system **600** performs specific operations by processor **608** executing one or more sequences of one or more instructions contained in memory **602**. For example, instructions for the motion system **100** or other systems described herein may be contained in memory **602** and may be executed by the processor **608**. Such instructions may be read into memory **602** from another computer readable/usable medium, such as static storage **604** or dynamic storage **606**. In alternative embodiments, hard-wired circuitry may be used in place of or in combination with software instructions. Thus, particular embodiments are not limited to any specific combination of hardware circuitry and/or software. In various embodiments, the term "logic" means any combination of software or hardware that is used to implement all or part of particular embodiments disclosed herein.
(43) The term "computer readable medium" or "computer usable medium" as used herein refers to any medium that participates in providing instructions to processor **608** for execution. Such a medium may take many forms, including but not limited to, nonvolatile media and volatile media. Non-volatile media includes, for example, optical or magnetic disks, such as static storage **604** or dynamic storage **606**. Volatile media includes dynamic memory, such as memory **602**.
(44) Computing system **600** may transmit and receive messages, data, and instructions, including program, e.g., application code, through communications link **618** and communications interface **616**. Received program code may be executed by processor **608** as it is received, and/or stored in static storage **604** or dynamic storage **606**, or other storage for later execution. A database **614** may be used to store data accessible by the computing system **600** by way of data interface **612**. In various examples, communications link **618** may communicate with the motion system **100** or other systems described herein.
(45) Any of the features, components, and/or parts, including the arrangements and configurations

thereof shown in any one of FIG. **6** 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. **6**.

(46) Turning to FIGS. **7-10**, example systems **700** providing an interactive user experience are depicted. The system **700** depicted in FIG. **7** may provide interactive content **752** to a user **701** for immersive interaction. The system **700** may display a visual portion **755** of the interactive content **752** to the user **701** and include a movement inducing or modular floor **720** to simulate, induce, and/or create movement or actions for the user **701**.

(47) The modular floor **720** may be, or include, similar or the same features as the modular floor **102** discussed above. For example, modular floor **720** may include a plurality of active tiles **722** that may be similar to or the same as the plurality of active tiles **104** described above. The active tiles **722** may similarly include disk assemblies **130**. The disk assemblies **130** of the tiles **722** may move an object in a variety of directions (e.g. omnidirectional).

(48) The tiles **722** may be positioned adjacent another tile **722**. The tiles **722** or disk assemblies **130** may be arranged in a variety of sizes (e.g. the widths of the tiles **722** or disk assemblies **130**) or spacings (e.g. the distance between tiles **722** or disk assemblies **130**). The spacings of the tiles **722** may be selected to limit or prevent objects from being placed between tiles **722**. For example, to provide movement to an object at least one tile **722** must be in contact with the object. In some examples, the tiles **722** or disk assemblies **130** may be positioned closely or tightly together. For example, the tiles **722** or disk assemblies **130** may be positioned adjacent one another for objects or user's **701** feet **707** to span a distance between the tiles **722** or disk assemblies **130**. The tighter spacing may prevent or reduce the risk of a user's **701** foot **707** from unintentionally being placed between tiles **722** or disk assemblies **130**. The tighter spacing may position tiles **722** for a user to place their feet on two or more tiles **722** or disk assemblies **130** at any time and therefore to be moved over the floor **720** by the active tiles **722**. Accordingly, the tiles **722** or disk assemblies **130** may be arranged such that a distance between two tiles **722** is less than a length or width of an object likely to be placed on the tiles **722**.

(49) The tiles **722** may be arranged in various shapes. In some examples, the active tiles **722** may include the same or similar shape, such that multiple tiles **722** may be connected or positioned together to form the modular floor **720**. For example, the active tiles **722** may include a polygonal shape for multiple tiles **722** to be connected together to form an integrated surface of the modular floor **720**. In one example, the tiles **722** are arranged in a hexagonal shape. In other examples, the tiles **722** may be rectangular, triangular, or arranged into a pattern. The modular floor **720** as a whole may similarly be shaped into a variety of polygons or thematic patterns.

(50) The disk assemblies **130** may move in a similar direction or orientation thereby defining a direction of movement for the tile **722** as a whole. As discussed above, the disk assemblies **130** of an active tile **722** may be driven independently of other disk assemblies **130** of the active tile **722**, or together in a similar or same direction. Similarly, active tiles **722** may drive or impart movement in a direction different from or the same as a neighboring active tile **722**. Note that while reference may be given to a disk assembly **130** or an active tile **722**, in some examples of the system **700** the terms may be used interchangeably. For example, an active tile **722** may include a single disk assembly **130**.

(51) The tiles **722** may rotate objects by two or more tiles **722** or disk assemblies **130** providing movement in transverse directions. For example, two adjacently spaced tiles **722**, such as a first tile **725** and a second tile **726**, may define an axis of rotation **731**. The various shapes or sizes of the tiles **722** may assist in orienting objects on the modular floor **720**. For example, the shapes of the tiles **722** may be arranged such that intersections between tiles **722** allow objects to pass between

tiles **722** or rotate relative to the tiles **722**. In an example of a hexagonal tile **722** configuration, a third tile **727** may meet at the axis of rotation **731**. Three or more tiles **722** may provide translational and rotational movement.

(52) The modular floor **720** may be located on a platform **715**. The platform **715** may support the modular floor **720** and include a surrounding or stationary floor **718**. The stationary floor **718** may be positioned adjacent the modular floor **720**. For example, a boundary **745** may be defined between the modular floor **720** and the stationary floor **718**. In one example, the stationary floor **718** may extend around a perimeter of the modular floor **720**, the boundary **745** defining the perimeter. The stationary floor **718** may provide a location for a user **701** to wait prior to stepping on to the modular floor **720**. The stationary floor **718** may provide a location for additional users, spectators, or other personal to stand adjacent to the modular floor **720**.

(53) The system **700** may include a display or display system **750**. The display **750** may be a screen or wearable device providing visual feedback to a user **701**. The visual feedback may be the visual portion **755** of the interactive content **752**. For example, the display **750** may be an electronic screen or a surface configured to receive a projected image. In some examples, the display **750** may be a virtual reality or augmented reality headset or optical device. In some examples, the system **700** may include various audio systems to provide sound or music.

(54) The display **750** may include a projector **770**. The projector **770** may generate one or more images **773**. The image **773** generated by the projector **770** may be arranged to create the illusion of depth or texture on a projected surface. In some examples, the display **750** is a primary display and the projector **770** is a secondary display. For example, the projected image **773** may correspond to an image on the display **750**. In some examples, the image **773** or the display **750** may produce 3D images viewable by a user **701**, such as by glasses or headsets. Accordingly, the system **700** may simulate depth or textures.

(55) The system **700** may include one or more sensors **760**. The sensors **760** may detect positions, orientations, or movement of various objects or users on the modular floor **720**. For example, the sensors **760** may include a light detection and ranging system (LIDAR), two or more associated cameras, a wearable motion capture device or system, or other systems detecting light or distance to determine a position of an object. The sensors **760** may include pressure sensors, accelerometers, or other devices capable of detecting weight or changes in movement. The sensors **760** may be positioned in various locations of the system **700**. For example, the sensors **760** may include a first grouping of sensors **763** in a first location and a second grouping of sensors **766** in a second location. In some examples, the sensors **760** may be included in one or more of the previously discussed components. Positioning sensors **760** in various locations may increase the accuracy or amount of detected positions or movements of objects.

(56) With respect to the user **701**, the sensors **760** may detect various features of a user's body or various gestures indicated by the user's body. For example, the sensors **760** may detect the user's head **703**, arms **704**, upper body or torso **705**, legs **706**, or feet **707**. The sensors **760** may detect the various orientations or movements of the user's **701** respective anatomy, such as relative positions of the legs **706** or feet **707** compared to the rest of the user **701**. For example, the sensors **760** may detect movement of the user **701** by a change in position of the user's anatomy, such as a change in position of the legs **706** relative to one another. The positions of the user's anatomy may also be detected as an input to the system **700**. For example, the sensors **760** may detect gestures or movements of the user intended to convey meaning, as may be discussed in greater detail with reference to FIG. **9**. In one example, an extended arm **704** or gesture may be detected as an input indicating a desired direction of movement responsive to the interactive content **752** or a selection of an option provided by the interactive content **752**. In some examples, the gestures of the user **701** may control objects the user's **701** own movement on the modular floor **720** or the movement of another user.

(57) In some examples, the system **700** may include the object **710**. The object **710** may be any

object movable by the floor **720**. In some examples, the object **710** may include thematic features or elements corresponding to the interactive content **752**. For example, the object **710** may correspond to a character of the interactive content **752**. In some examples, the object **710** may be used to simulate interaction with simulated objects of the interactive content **752**. In some examples, the image **773** may be displayed on the object **710** to provide depth to the image **773**. In some examples, the gestures of the user **701** discussed above, may be used to control movement of the object **710**.

(58) Turning to the system as a whole with continued reference to FIG. **7**, a user **701** or an object **710** may be positioned on the modular floor **720** for the immersive interactive experience provided by the interactive content **752**. The system **700** may generate an immersive interactive experience for the user **701** to move naturally or independently while on the modular floor **720**. The movements of the user **701** or movements of the active tiles **722** may correspond to visual content **755** of the interactive content **752**, providing an immersive experience to the user **701**, e.g., allow the user **701** to actually experience movement in a manner that corresponds to the content **752** that is not possible with other types of video gaming experiences.

(59) With respect to the interactive content **752**, the interactive content **752** may simulate a three dimensional virtual environment such as a world, game, or other interactive experience. The interactive content **752** may provide visual portions or visual content **755** providing visual representations of the virtual environment. The interactive content **752** may simulate and/or recreate physical feedback of the virtual environment with the modular floor **720**. For example, terrain of the virtual environment may be simulated by the movement generated by the modular floor **720** or the responses of the modular floor **720** to the movements of the user **701**.

(60) The display **750** may be positioned adjacent the modular floor **720** and within a field of view of the user **701** or the display **750** may be a wearable device worn by the user **701**. In examples where the display **750** is a wearable device, a separate display **750**, such as a screen, may be included or omitted from the system **700**. The display **750** or projector **770** may display the visual content **755** of the interactive content **752** to the user **701**. The projector **770** may project the images **773** on the modular floor **720**, or elsewhere on the system **700**, to increase the immersive experience. In various examples, the projector **770** and the display **750** may be used together. For example, the image **773** or display **750** may supplement the other. For example, one of the display **750** or the projector **770** may provide a main visual content for viewing by the user **701** and the other may generate an extension of, or background corresponding to, the main visual content. In other examples, the system **700** may use only the projector **770** or the display **750**.

(61) The sensors **760** may be positioned adjacent the modular floor **720**. The sensors **760** may monitor positions, movements, or orientations of the user **701**. In some examples, an object **710** is additionally placed on the modular floor **720** and the sensors **760** may monitor the position, movement, or orientation of the object **710**. In examples with multiple sensors **760**, the sensors **760** may be spaced apart or positioned at various sides of the modular floor **720** to assist in determining positions or movements (e.g. triangulate) of the user **701** or object **710**. For example, the first grouping or plurality of sensors **763** may be spaced from the second grouping or plurality of sensors **765**.

(62) With respect to the sensors **760**, the sensors **760** may detect the various movements or positions of the user **701** or the object **710** in relation to the modular floor **720**. The modular floor **720** may be in communication with the sensors **760** or the interactive content **752**. The movement generated by the modular floor **720** may correspond to information detected by the sensors **760** or generated by the interactive content **752**. In some examples, sensors **760** may be included in the modular floor **720** or in devices carried or worn by the user **701**. For example, sensors **760** in the modular floor **720** may determine which active tile **722** or disk assembly **130** may be in contact with a user **701** or object **710**. Sensors **760** on the user **701** may assist in detecting motion, movements, or orientations of the user **701**.

(63) When the user **701** is on the modular floor **720**, the modular floor **720** may simulate movement or environments corresponding to the interactive content **752**. To simulate movement corresponding to the interactive content **752**, the active tiles **722** of the modular floor **720** may move in response or impart motion on the user **701**. For example, the active tiles **722** may generate motion to counteract a user's **701** movement, increase the effect of the movement, or induce movement of the user **701** in varying additional directions. The sensors **760** may communicate the user's **701** position to the modular floor **720** to improve the immersive experience. For example, the sensors **760** may determine the user **701** is taking steps of a certain stride length and correspondingly activate or manipulate tiles **722**. The sensors **760** may detect the user **701** is leaning, oriented, or balanced in a certain manner and activate the tiles **722** in a corresponding manner to keep the user **701** upright. The sensors **760** may also detect when the user **701** is nearing the boundary **745** of the modular floor **720** and either move the user **701** away from the boundary **745** or provide visual or audio feedback to alert the user **701**.
(64) In an example of user **701** movement, the user **701** may begin walking in a first direction **780**. To maintain the user **701** in a location on the modular floor **720**, the active tiles **722** may generate movement in a second direction **782** opposite to the first direction **780**. By providing motion in a second direction **782** different from the first direction **780**, the active tiles **722** may counter the walking motion of the user **701** and simulate walking in the interactive content **752**. In various examples, the modular floor **720** may simulate or allow running, jumping, or a variety of other movements in a virtual environment for the user **701**. Further, the modular floor **720** may generate motion in different directions or magnitudes than movement by the user **701**. For example, the differing direction or magnitudes of movement generated by the modular floor **720** may simulate slipping, falling, sliding, uneven terrain, or various other experiences.
(65) In some examples, the modular floor **720** may move a stationary user **701** or object **710**. For example, with reference to the object **710**, to move a stationary feature in a desired direction **785**, the active tiles **722** may also generate movement in a direction **787** aligned with the desired direction **785**. The system **700** may position objects **710** by the modular floor **720** to interact with the user **701**. In some examples, the system **700** may move the user **701** to facilitate engagement with the interactive content **752**.
(66) The system **700** may include the computing system **600** as described with respect to FIG. **6**. For example, the interactive content **752** may be instructions read into the memory **602** or stored in another computer readable/usable medium, such as the static storage **604** or the dynamic storage **606**. The processor **608** may be in electrical communication with the display **750** or projector **770** to display visual portions **755** of the interactive content **752**. The processor **608** may be in communication with the sensors **760** or modular floor **720**. For example, the processor **608** may generate instructions or commands to the modular floor **720** in response to a detected position of the user **701** by the sensors **760**. Similarly, the processor **608** may communicate with the display **750** to modify the visual content **752** in response to an input, action, movement, or orientation of the user **701**.
(67) In operation, a user **701** of the system **700** may be positioned on the modular floor **720**. The visual portion **755** of the interactive content **752** may be displayed to the user **701**. In a specific example, the interactive content **752** may correspond to a hike through a wilderness. The visual portion **755** may be displayed by the projector **770** or the display **750**. For example, the visual portion **755** at the display **750** may be depict a wide-ranging view of the virtual environment. The projector **770** may provide an image **773** depicting immediate surroundings of the user **701** in the virtual environment. With reference to the specific example, the visual portion **755** at the display **750** may show a forest and horizon of the wilderness, and a path extending through the wilderness. The visual portion **755** represented by the image **773** may depict the path the user **701** is traversing. As the user **701** walks, the visual portion **755** may update to show different perspectives based on the orientation of the user **701** or their simulated progress in the virtual environment.

(68) The user **701** may move in a manner corresponding to the interactive content **752** by the modular floor **720**. As discussed above, the sensors **760** may monitor the positions of the user **701**. The modular floor **720** may move in a manner corresponding to the detected position, orientation, or movement of the user **701** as detected by the sensors **760**. For example, the modular floor **720** may move the user **701** in a manner corresponding to the interactive content **752** or the user's **701** actions in relation to the interactive content **752**. With reference to the specific example, the user **701** may walk as if they are following a trail and the modular floor **720** may move to counter the steps of the user **701** to maintain the user's position on the modular floor **720**. The interactive content **752** may correspond to a virtual environment including slippery conditions on a trail, such as mud or ice. Correspondingly, the modular floor **720** may simulate the slippery conditions by moving the user's **701** feet **707** in varying directions while on the modular floor **720**. In some examples, the system **700** may also include speakers or other devices to generate audio corresponding to the user's **701** movements or the interactive content **752**. For example, the motion of the modular floor **720** may be modulated by the audio of the interactive content **752**. In one example, sounds similar to a person walking or sliding on gravel may be played with a step of the user **701** on the modular floor **720** to increase the immersion in the simulated hiking experience. In other examples, the music or special effect sounds may be produced responsive to the user performing an action.
(69) Accordingly, the system **700** provides benefits that are not otherwise possible with existing systems or technologies. For example, because the system **700** and the modular floor **720** both induce movement and enable movement of the user **701**, the user **701** may physically feel, or engage with, the interactive content **752** or simulated experiences. Accordingly, the present system **700** allows both physical and visual immersion with interactive content **752**. In contrast, other systems may be limited to only visual feedback or only receive limited movements or physical feedback from the user. For example, current systems may only allow limited physical feedback through haptics on a handheld controller or detect movements of the handheld controllers. In some examples, the movement or induced movement of the user **701** by the modular floor **720** may also provide a cardio experience or other physical exertion adding to the realism of the interactive content **752** and providing new possibilities for both content creators and users. Further, the system **700** and modular floor **720** enables physical feedback in a limited or relatively small geographic area, which would otherwise only be possible in a large geographic space.
(70) Any of the features, components, and/or parts, including the arrangements and configurations thereof shown in any one of FIG. **7** 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. **7**.
(71) Continuing to FIG. **8**, an example of the system **700** including two or more users **701** is illustrated. The system **700**, as depicted in FIG. **8**, may also include an elevating assembly **735** to provide modular floor **720** with a varying slope or grade (e.g. simulate vertically oriented movement). The system **700** may also include input devices **775** to receive an input to the system **700** from one or more users **701**.
(72) The system **700** in FIG. **8** may similarly include a modular floor **720** with a plurality of tiles **722**. The modular floor **720** may be on a platform **715**. The platform **715** may include stationary floor **718** around the perimeter **745** of the modular floor **720**.
(73) The modular floor **720** may further include the elevating system or assembly **735**. The elevating assembly **735** may raise or slope one or more tiles **722** to define a difference in elevation or elevated surface **736**. The elevating assembly **735** may also lower one or more tiles **722**. Relative to the non-elevated tiles, the elevated surface **736** may be sloped (e.g. smooth transition) or angled

(e.g. abrupt transition). While the tiles **722** of the elevated surface **736** are depicted as being separated from the non-elevated tiles **722**, the elevating assembly **735** may be arranged under modular floor **720** in a manner to keep active tiles **722** in contact with adjacent tiles **722**. In some examples, the entire modular floor **720** may be raised, reoriented, or elevated. The elevated surface **736** may simulate vertical changes or sloping surfaces corresponding to the interactive content **752**.
(74) The system **700** may similarly include a display **750** or a projector **770** to display visual portions **755** of the interactive content **752** or images **773**. The system **700** may also include one or more sensors **760** to monitor, positions, orientations, or actions by a user **701**.
(75) As depicted in a FIG. **8**, a first user **701** may similarly move on or be moved by the modular floor **720**. For example, the user **701** may desire to move in a first direction **780** and the modular floor **720** may act to maintain the users' position and simulate movement by causing relative motion in a direction **782** transverse to the first direction. As depicted in FIG. **8**, a third party or second user **712** may interact with the system **700**. The second user **712** may be positioned on or adjacent the modular floor **720** along with the first user **701**. In some examples, the second user **712** may be positioned on the stationary floor **718** for interaction with the system **700**, or in various other positions. The sensors **760** may track positions, orientations, movements, or relative positions of either user **701**, **712** or both users **701**, **712** together.
(76) Similar to the first user **701**, the second user **712** may move on or be moved by the modular floor **720** in a manner corresponding to the interactive content **752**. For example, the secondary user may desire to move in a primary direction **790**. The system **700** may use the sensors **760** to determine the movement of the second user **712** and correspondingly manipulate the tiles **722** to move the user in a secondary direction **792** to counter the secondary user's **712** movement. The tiles **722** corresponding to the first user **701** may be independent of the tiles corresponding to the secondary user **712**. Accordingly, both the first user **701** and the second user **712** may engage with the interactive content **752** at the same time.
(77) In some examples with two or more users **701**, the users **701**, **712** may experience the same interactive content **752** or interactive content **752** independent or separate of the other user **701**, **712**. For example, the users **701**, **712** may have their own displays **750** (e.g. two or more screens or headsets) and the displays **750** may produce different interactive content **752**, or different visual portions **755** of the interactive content **752**. Accordingly, two or more immersive experiences may be operated on a single modular floor **720**. In some examples, the interactive content **752** may be tied to a proximity of the user **701** to a location on the floor **720** or to another user **712**. For example, the interactive content **752** may transition from a first interactive content **752** or first visual portion **755** to a second interactive content **752** or second visual portion **755** by a user moving nearer another location or user **701**.
(78) In some examples, the system **700** includes input devices **775** for receiving an input from the users **701**, **712**. The input devices **775** may be a controller, mobile device, wearable device, or a variety of other devices in communication with the system **700**. For example, the input devices **775** may include sensors **760**, switches, buttons, or screens to receive an input from the users **701**, **712**. The input devices **775** may be in communication with or used in combination with the sensors **760**. The inputs may correspond to the interactive content **752**. For example, the interactive content **752** may simulate an action that would require ductile movement (e.g. fine or discrete motor movements), and the input device **775** may be designed to receive the input from the ductile movement. The input devices **775** may also provide feedback to the users. For example, the input devices **775** may vibrate, generate an additional display, or other feedback.
(79) In some examples, the input received by one user (e.g. user **701**) may affect another user (e.g. user **712**). For example, the input may correspond to the virtual environment of the interactive content **752**, such as the visual portion **755**. In some examples, the input may change the motion of active tiles **722** corresponding to the user **712**. Accordingly, users may engage with each other through inputs or the interactive content **752**.

(80) While description is given with respect to the two users **701**, **712** shown in FIG. **8**, it is appreciated that any numbers of users (e.g. a plurality of users) may utilize or interact with the system **700**. The total number of the plurality of users may be limited only by the number of users that are able to fit on or adjacent the modular floor **720** (e.g. the size of the modular floor **720** or platform **715**). In examples with a plurality of users, the sensors **760** may detect the plurality of users individually. The sensors **760** may be in communication with the modular floor **720**, or individually with the tiles **722** or disk assemblies **130**. Accordingly, as long as an independent tile **722** or disk assembly **130** is available for one of the plurality of users, the modular floor **720** may induce or respond to a motion of any of the plurality of users as detected by the sensors **760**.
(81) Any of the features, components, and/or parts, including the arrangements and configurations thereof shown in any one of 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**.
(82) FIG. **9** depicts an example of the interactive system **700** where a user **701** can control the movement of an object **710** by the modular floor **720**. The user **701** may control the movement of the object **710** through gestures, actions, or body language detected by the sensors **760**.
(83) The system **700** depicted in FIG. **9** may include similar features as described above with respect to FIGS. **7** and **8**. For example, the system **700** may include the modular floor **720** including a plurality of active tiles **722**. The modular floor **720** may be located on a platform or region **715**. The platform **715** may include stationary floor **718** adjacent the modular floor **720**.
(84) The system **700** may include a display **750** for depicting a visual portion **755** of interactive content **752**. The system **700** may include a one or more sensors **760**. For example, the sensors **760** may include a first group of sensors **763** and a second group of sensors **766**.
(85) The user **701** of the system **700** may have multiple body parts or appendages detectable or distinguishable by the sensors **760**. For example, as discussed above, the user **701** may have a head **703**, an arm **704**, a torso or upper body **705**, legs **706**, or feet **707** one or all of which may be detectable by the system **700**. The various arrangements of the user's **701** appendages may be intended to convey meaning. For example, the arrangement of appendages may correspond to a gesture, action, body language, or where a user **701** may be directing their attention, where the system **700** may detect certain gestures or actions and correlate those to a particular input or instruction. In this way, the system can readily adapt to different immersive environments and games that allow multiple types of user input and interactions, which may not be possible with conventional game input devices.
(86) The system **700** may include one or more objects **710** that may correspond to various types of items. For example, the object **710** may be one or more of a feature corresponding to the interactive content **752** (e.g. a feature having or corresponding to a thematic element), an item containing or supporting a second object (e.g. shipping container, boxes, etc.), or another user. In some examples, one or more combinations of items may be included.
(87) During use of the system **700**, the user **701** may be positioned on the platform **715**. The user **701** may be located on the modular floor **720** or the stationary floor **718** adjacent the modular floor **720**. The object **710** may be positioned on the modular floor **720**. The various sensors **760** may detect the positions or orientation of the user **701** or the object **710**. For example, the first group of sensors **763** may be directed to the modular floor **720** to detect the positions, orientations, or movements of the object **710**. The second group of sensors **766** may be directed to the user **701** to detect the gestures, positions, orientations, or movement of the user **701**.
(88) As an input to the system **700**, the user **701** may move one or more appendages corresponding to an action or gesture. For example, the user **701** may extend an arm **704** outward in a direction

relative to the object **710**. The extended arm **704** may indicate a desired direction of movement **785** or position of the object **710**. Accordingly, the sensors **760** detect the gesture and relative positions of the user **701** and object **710** and move the object **710** in a direction **787** corresponding to the desired direction of movement **785**. In some examples, the user **701** can point to the object **710** and/or move his or her appendage in some direction. The object **710** may be moved by the modular floor **720** to correspond with the movement of the appendage as though the object **710** were attached or linked to the moving appendage (e.g., to replicate a force or magical effect of the user on the object). In some examples, multiple objects **710** may be located on the modular floor **720**. The gestures or actions of the user **701** may correspond to a direction of movement for the multiple objects or a subset (e.g. one or more) of the objects **710**. In such examples, the sensors **760** may detect a body language or orientation of the user **701** relative to the objects to interpret the gesture. For example, a user **701** with his or her torso **705** square to an object and feet **707** pointed at a first object may indicate that the first object is the object **710** intended to be moved.

(89) In some examples, it is appreciated the gestures of the user **701** may correspond to an intended movement of the user **701** themselves. Accordingly, the system **700** may move the user **701** in a direction corresponding to their gesture, e.g., pointing an arm or finger in a certain direction can generate a forward motion in that same direction by the system **700** on the user.

(90) In some examples, it is appreciated that the user **701** and one or more of the sensors **760** may be remotely located from the modular floor **720**. Accordingly, the user **701**, through gestures or other inputs may remotely control the movement of the object **710** by the modular floor **720**.

(91) During use, the visual portion **755** of the interactive content **752** may correspond to the positions of the object **710** on the modular floor or content represented by the object **710**. In some examples, the interactive content **752** may be directed to assist in industrial use and the platform **715** may be located in a shipping yard or warehouse. The interactive content **752** may be a navigation or shipping system for moving the objects **710** through the warehouse. Accordingly, the visual portion **755** may be a map showing the movement of the object **710** through the warehouse. Such a system **700** may allow users **701**, such as workers, to quickly and easily move multiple objects without requiring training to operate heavy machinery.

(92) In some examples, the interactive content **752** may be a game or puzzle. In such an example, the object **710** may be positioned in a game area or maze. The visual content **755** may correspond to the game area and the user **701** may control the movement of the object **710** by the system **700**. Accordingly, the system **700** may provide an interaction with real world objects by inputs to the system **700**.

(93) Any of the features, components, and/or parts, including the arrangements and configurations thereof shown in any one of FIG. **9** 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. **9**.

(94) FIG. **10** depicts an example of the system **700** including a modular floor **720** arranged into multiple separate regions. In such an example, multiple users **701** may be located on or adjacent the various tile regions.

(95) The system **700** of FIG. **10** may include a platform **715** including the modular floor **720** and the stationary floor **718**. The modular floor **720** may include a plurality of active tiles **722** as previously discussed. The modular floor **720** may be arranged into multiple separate groupings or regions. For example, the modular floor **720** may be arranged into a first region **741**, a second region **742**, a third region **743**, or a fourth region **744**. The various regions may be separated by the stationary floor **718**. It is appreciated that any number of total number of regions may be used as are able to fit on the platform **715**, as may be determined by the size of the regions or the size of the

platform **715**. In some examples, the groupings of the modular floor **720** may not be physically separated, such as by the stationary floor **718**, but rather operated independently such that a first grouping moves or induces movement differently from an adjacent grouping. In one example, one of the two adjacent groupings of the tile floor **720** remains stationary and the other induces or responds to movement of the users.

(96) The system **700** of FIG. **10** may include one or more of the components previously described. The system **700** may include a display **750** to depict a visual portion **755** of interactive content **752**. In some examples, the display **750** may include or be a projector **770** generating an image **773** corresponding to the interactive content **752**. The system **700** may include one or more sensors **760** for detecting movements, positions, orientations of users **701**, as discussed previously. For example, the sensors **760** may include a first group of sensors **763** and a second group of sensors **766**.

(97) Multiple users may interact with the system **700**. For example, as depicted in FIG. **10**, there may be a first user **701**, a second user **712**, or a third user **714**. The users may be positioned at various locations on the platform **715** during use. For example, the first user **701** may be positioned on the first region **741** of the modular floor **720**. The second user **712** may be positioned on the stationary floor **718** adjacent the second **742** and third regions **743**. The third user **714** may be positioned on the fourth region **744** of modular floor **720**. The users may move or transition on or between the various regions.

(98) In operation, the sensors **760** may detect the positions, movements, or orientations of the various users. For example, the sensors **760** may detect the users individually. As the users move between or are positioned on the regions or groupings of the modular floor **720**, the modular floor **720** may be selectively activated to respond or impart motion on the users. For example, the first user **701** may be detected at the first region **741** of the modular floor **720** by the sensors **760**. The sensors **760** may be in communication with the first region **741** and cause motion **783**, such as rotational motion, of the user **701**. Similarly, the sensors **760** may detect the third user **714** is located at the fourth region **744** and move the user **714** in a direction **784** by the active tiles **722**. The sensors **760** may track the position of users not on the modular floor **720**, such as the second user **712**, so as to activate the modular floor **720** for the user when if they step on region of the modular floor **720**.

(99) In one example of the system **700** as depicted in FIG. **10**, the system **700** may be a theatrical production. In such an example, the users may be actors and the interactive content **752** may correspond to the narrative of the production. The platform **715** may be a stage and the various regions of modular floor **720** may be set into the stage **715**. For example, the modular floor **720** may be camouflaged or hidden from an audience within the stationary floor **718** of the stage **715**.

(100) The display **750** may depict visual content **755** corresponding to the narrative or thematic elements of the display. The projector **770** may generated images **773** providing visual effects to the production. In some example, the images **773** may be projected onto the users or actors to change their appearance or draw attention to certain actors. The modular floor **720** may maintain positions of the user relative to the projector **770** to improve the accuracy of the projected image **773** on the user. Accordingly, a more detailed image **773** may be projected accurately by using the modular floor **720**.

(101) During the production, the movement of the users **701** may correspond to a dance or choreographed routine. As the users move, the modular floor **720** regions may be utilized in the dance or routine to provide new possible combinations of movements. For example, the modular floor **720** may allow a user to run while staying in place, providing realism to an action that would require acting. In other examples, the modular floor regions **720** may allow a user to move at superhuman speeds or otherwise perform feats not otherwise possible during live entertainment. Further, by dispersing the modular floor **720** in multiple locations adjacent stationary floor **718**, the actor may move naturally on the stationary floor **718** then appear to magically gain speed or move

by stepping on the regions of the modular floor **720**.

(102) In some examples, the various regions of modular floor **720** may be operate independently but be used for a common purpose. One example may be the theatrical production described above. In some examples, groups of users are associated with the groups or regions of the modular floor **720** and the various groups may compete against one another in a game. Additional examples may include group exercise routines, where the interactive content **752** correspond to a workout routine.

(103) Any of the features, components, and/or parts, including the arrangements and configurations thereof shown in any one of FIG. **10** 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. **10**.

(104) Turning to FIG. **11**, an example method **900** for providing an interactive user experience using the system **700** as described herein is depicted. The method **900** may begin with step **910**. At step **910**, the system **700** may determine a simulated experience from interactive content **752**. For example, the interactive content **752** may be an outdoor adventure experience simulating a virtual environment. The system **700** may determine a beginning or starting point for a user **701** in the virtual environment. The system **700** may determine whether to activate either or both the projector **770** or display **750**. The system **700** may determine whether one or more users are on the modular floor **720**. Accordingly, the system **700** may arrange the interactive content **752** to receive separate inputs from the users or provide content responsive to the actions of the user.

(105) The method **900** may proceed to step **920**. At step **920**, the system **700** may display visual content **755** corresponding to the interactive content **752**. For example, the system **700** may include projectors **770** or a display **750**. The visual content **755** may be provided at the display **750** or as an image **773** provided by the projector **770**. In some examples, the display **750** may be a wearable device, such as a headset, worn by a user **701** and the visual content **755** may be provided to the user **701**.

(106) The method **900** may proceed to step **930**. At step **930**, the system **700** may determine a current orientation of the user **701** relative to the modular floor **720** by a sensor **760**. For example, the user **701** may be positioned on the modular floor **720**. The user **701** may be moving, oriented, or performing a variety of gestures. The sensors **760** may be positioned adjacent the modular floor **720**, within the modular floor **720**, or on the user **701**. The detected orientation of the user **701** may correspond to the user's engagement with the interactive content **752**. For example, in a simulated experience providing an outdoor adventure experience the user **701** may be moving or positioned to climb or hike a virtual trail. The system **700** may detect or determine which active tiles **722** of the modular floor **720** the user **701** is positioned on.

(107) The method **900** may proceed to step **940**. At step **940**, the system **700** may manipulate a position of the user **701** by the modular tile floor **720** responsive to the simulated experience or current orientation of the user **701**. For example, if the current orientation of the user **701** corresponds to the user **701** walking, the modular floor **720** may move the user **701** counteract the user's **701** steps. If the simulated experience provided by the interactive content **752** provides a slippery trail or ice, the tiles **722** may move the user's **701** feet **707** on the active tiles **722** to simulate the slippery conditions.

(108) Any of the features, components, and/or parts, including the arrangements and configurations thereof shown in any one of FIGS. **7-11** 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. **7-11**. Additional arrangements or uses of the system **700** are contemplated herein. Some examples are provided below.

(109) In some examples, the visual portion **755** of the interactive content **752** is displayed by the projector **770**. For example, the image **773** may be the visual portion of the interactive content. The visual portion **755** may correspond to a map or image of a location or region. Various objects **710** may be placed on the modular floor **720** to provide depth, texture, or assist in simulating the interactive content **752**. For example, the objects **710** may represent map locations or regions. Users **701** may navigate the modular floor **720** to simulate traversing the map or region. In some examples, portions of the map may be depicted by the image **773**, and the image **773** may update as the user **701** moves to simulate traversing the map. Accordingly, the system **700** may use the interactive content **752** for map-based games or educational tools. The system **700** may provide audio, visual, or physical effects corresponding to the region. For example, interactive content **752** including a map of California may simulate earthquakes by shaking or oscillating the modular floor **720**. A map of a desert may simulate walking on sand by simulating shifting sands by moving the modular floor **720** to shift the user's **701** feet **707**.

(110) In some examples, the system **700** may be used for games. The system **700** may similarly project an image **773**, such as a game board or game area, on the modular floor **720** corresponding to the game. In one example, the interactive content **752** of the system **700** is a tag game. For example, multiple users **701** may be on the modular floor **720** and move towards or away from each other. The image **773** may simulate obstacles, traps, boosts, or other game related content. The modular floor **720** may vary the speeds of the users **701** corresponding to the interactive content **752** (e.g. game rules). For example, some users **701** may have different assigned movement abilities and the modular floor **720** may independently adjust the speed of the users **701** by counteracting or assisting their movement by the floor **720**. In some examples, a user **701** may be prohibited from moving by the interactive content **752** (e.g. freeze tag), and the modular floor **720** may move the user **701** back to a location if the user **701** attempts to leave.

(111) In some examples, the objects **710** may be used with interactive content **752** corresponding to games. For example, the interactive content **752** may correspond to chess and the user **701** may either control chess pieces on the modular floor **720**, which may be simulated or represented by objects **710** placed in assigned locations on the floor **720**. In some examples, the user **701** may act as a chess piece and be moved by the modular floor **720**. Various other games may similarly use objects **710**, such as a bowling simulator, where a virtual ball may be thrown by the user **701** and the modular floor **720** may move or knock down pins corresponding to the user's **701** throw. In some examples, the user **701** may imitate a virtual ball where the user **701** bowls over virtual pins displayed on the modular floor **720** (e.g. by image **773**) and/or on the display **750** as a visual portion **755**.

(112) In some examples, the system **700** may be used for health and fitness exercises. For example, the modular floor **720** may act as a running or walking platform. The interactive content **752** may be workout programs such as fitness classes or agility training programs. Accordingly, the modular floor **720** may move the users **701** or facilitate movement by the user **701** in a manner corresponding to the fitness programs. The present system **700** may differ from existing workout equipment having a display because the modular floor **720** provides a greater immersion in the workout program (e.g. interactive content **752**). For example, the modular floor **720** may enable the user **701** to walk or move in a variety of directions in contrast to existing workout equipment commonly allowing only a single predefined method or direction of movement. In some examples, the modular floor **720** may also adapt to characteristics of the user's **701** workout, such as changes in pace of the user **701** as detected by sensors **760** or orientation relative to the floor **720** as detected by sensors **760**, or updating the visual content **755** corresponding to the user's **701** actions, such as a new virtual environments reached by traveling a simulated distance or a next workout or circuit.

(113) The description of certain embodiments included herein is merely exemplary in nature and is in no way intended to limit the scope of the disclosure or its applications or uses. In the included detailed description of embodiments of the present systems and methods, reference is made to the accompanying drawings which form a part hereof, and which are shown by way of illustration specific to embodiments in which the described systems and methods may be practiced. These embodiments are described in sufficient detail to enable those skilled in the art to practice presently disclosed systems and methods, and it is to be understood that other embodiments may be utilized, and that structural and logical changes may be made without departing from the spirit and scope of the disclosure. Moreover, for the purpose of clarity, detailed descriptions of certain features will not be discussed when they would be apparent to those with skill in the art so as not to obscure the description of embodiments of the disclosure. The included detailed description is therefore not to be taken in a limiting sense, and the scope of the disclosure is defined only by the appended claims.
(114) From the foregoing it will be appreciated that, although specific embodiments of the invention have been described herein for purposes of illustration, various modifications may be made without deviating from the spirit and scope of the invention.
(115) The particulars shown herein are by way of example and for purposes of illustrative discussion of the preferred embodiments of the present invention only and are presented in the cause of providing what is believed to be the most useful and readily understood description of the principles and conceptual aspects of various embodiments of the invention. In this regard, no attempt is made to show structural details of the invention in more detail than is necessary for the fundamental understanding of the invention, the description taken with the drawings and/or examples making apparent to those skilled in the art how the several forms of the invention may be embodied in practice.
(116) As used herein and unless otherwise indicated, the terms “a” and “an” are taken to mean “one”, “at least one” or “one or more”. Unless otherwise required by context, singular terms used herein shall include pluralities and plural terms shall include the singular.
(117) Unless the context clearly requires otherwise, throughout the description and the claims, the words ‘comprise’, ‘comprising’, and the like are to be construed in an inclusive sense as opposed to an exclusive or exhaustive sense; that is to say, in the sense of “including, but not limited to”. Words using the singular or plural number also include the plural and singular number, respectively. Additionally, the words “herein,” “above,” and “below” and words of similar import, when used in this application, shall refer to this application as a whole and not to any particular portions of the application.
(118) Of course, it is to be appreciated that any one of the examples, embodiments or processes described herein may be combined with one or more other examples, embodiments and/or processes or be separated and/or performed amongst separate devices or device portions in accordance with the present systems, devices and methods.
(119) Finally, the above discussion is intended to be merely illustrative of the present system and should not be construed as limiting the appended claims to any particular embodiment or group of embodiments. Thus, while the present system has been described in particular detail with reference to exemplary embodiments, it should also be appreciated that numerous modifications and alternative embodiments may be devised by those having ordinary skill in the art without departing from the broader and intended spirit and scope of the present system as set forth in the claims that follow. Accordingly, the specification and drawings are to be regarded in an illustrative manner and are not intended to limit the scope of the appended claims.

Claims

1. An interactive user experience system comprising: a processor; a display in electrical communication with the processor and configured to display a visual content of interactive content;

a modular tile floor in electrical communication with the processor and comprising: a plurality of tiles configured to move independently to induce or respond to a desired motion for a user in contact with the modular tile floor; an object positioned on the modular tile floor, wherein the object is separate from the user and positioned to define a gap between the object and the user along the modular tile floor, and wherein a position of the object is controlled by the modular tile floor; and a sensor in electrical communication with the processor, wherein the sensor is configured to detect at least one of an orientation or a position of the user on the modular tile floor, and determine a gesture of the user, the gesture indicating a desired direction of movement of the object; wherein based on the detected orientation or position of the user, the processor is configured to modify at least one of the visual content or a movement of at least one of the plurality of tiles, and wherein the processor is configured to move the object in a direction corresponding to the desired direction of movement of the object.

2. The interactive user experience system of claim 1, wherein the display is one or more of a wearable display, a projector, or an electronic screen.

3. The interactive user experience system of claim 2, wherein the display comprises the projector and the projector is configured to display the visual content on the modular tile floor.

4. The interactive user experience system of claim 1, wherein the visual content depicts a simulated environment.

5. The interactive user experience system of claim 4, wherein: the sensor is further configured to detect a motion of the user as feedback corresponding to the interactive content; wherein based on the detected motion of the user, the processor modifies the movement of the at least one of the plurality of tiles; and the movement of the at least one of the plurality of tiles changes the position of the user corresponding to the motion of the user.

6. The interactive user experience system of claim 1, further comprising: an elevating system configured to raise or lower a first set of tiles of the plurality of tiles to define a difference in elevation relative to a second set of tiles of the plurality of tiles; wherein the difference in elevation corresponds to the visual content.

7. The interactive user experience system of claim 1, wherein the visual content is correspondingly updated in response to one or more of a change in the position of the user, a change in the orientation of the user, or a motion of the user.

8. The interactive user experience system of claim 1, wherein the sensor is one or more of a light ranging and detection system, a camera, or a wearable motion capture device.

9. The interactive user experience system of claim 1, wherein: the sensor is configured to determine the position of the user on the modular tile floor; and the desired motion prevents the user from crossing a boundary of the modular tile floor.

10. The interactive user experience system of claim 1, further comprising: an input device in communication with the processor or the modular tile floor and corresponding to the interactive content; wherein the input device is configured to receive an input from the user and provides feedback to the user.

11. The interactive user experience system of claim 10, wherein the input device is configured to receive a second input from a second user different from the user, the second input providing feedback to the user.

12. The interactive user experience system of claim 1, wherein the movement of the at least one of the plurality of tiles is correspondingly updated in response to one or more of a change in the position of the user, a change in the orientation of the user, a motion of the user, or a change in the visual content.

13. The interactive user experience system of claim 1, wherein the object is an inanimate object.

14. A method for providing an interactive user experience with a modular tile floor, the method comprising: determining a simulated experience from interactive content; displaying visual content to a first user and a second user corresponding to the interactive content; determining a current

orientation of the first user and the second user relative to the modular tile floor by a sensor; manipulating a position of the first user and the second user by the modular tile floor responsive to the simulated experience and the current orientation of the first user and the second user; receiving an input from the first user to control a movement of the second user on the modular tile floor; and changing, based on the input from the first user, a motion of the modular tile floor corresponding to the second user.

15. The method of claim 14, further comprising: determining an action of the first user by the sensor; and providing feedback to the first user by the modular tile floor, the feedback corresponding to the action and the interactive content.

16. The method of claim 14, further comprising: determining an action of the first user by the sensor; and updating the visual content corresponding to the action and the interactive content.

17. The method of claim 14, further comprising: receiving a user input from a user device; and providing feedback to the first user corresponding to the user input and the interactive content.

18. The method of claim 14, further comprising: manipulating a position of at least one object on the modular tile floor.

19. The method of claim 18, wherein the manipulating the position of the at least one object comprises: determining a gesture of the first user or the second user, the gesture indicating a desired direction of movement of the at least one object; and moving the at least one object in a direction corresponding to the desired direction of movement of the at least one object.