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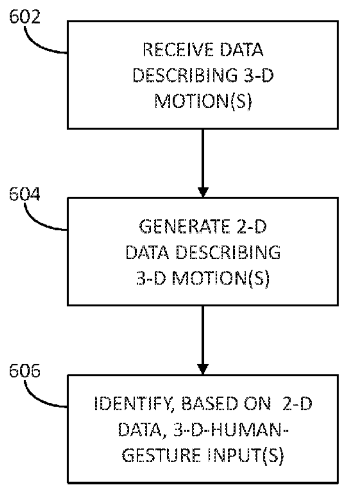

FIG. 6

(57) Abstract: The present disclosure is directed to identifying three-dimensional-human-gesture input. In particular, the methods and systems of the present disclosure can: receive from one or more sensors, data describing one or more three-dimensional motions comprising a three- dimensional-human-gesture input; generate, based at least in part on the data describing the one or more three-dimensional motions, two-dimensional data at least partially describing at least one motion of the one or more three-dimensional motions; and identify, based at least in part on the two-dimensional data, the three-dimensional-human-gesture input.

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METHODS AND SYSTEMS FOR IDENTIFYING THREE-DIMENSIONAL-HUMAN-GESTURE INPUT

PRIORITY CLAIM

[0001] This application claims priority to U.S. Patent Application Serial No. 62/678,240, filed May 30, 2018, and entitled “METHODS AND SYSTEMS FOR IDENTIFYING THREE-DIMENSIONAL-HUMAN-GESTURE INPUT,” the disclosure of which is incorporated by reference herein in its entirety.

FIELD

[0002] The present disclosure relates generally to human-computer interaction. More particularly, the present disclosure relates to identifying three-dimensional-human-gesture input.

BACKGROUND

[0003] Computing devices (e.g., smartphones, and/or the like) can provide (e.g., display on a display screen, and/or the like) a user interface that enables the computing device to interact with a user, including, for example, receipt of commands from the user, providing (e.g., displaying, and/or the like) information to the user, and/or the like. Some computing devices allow for gesture based inputs. Such devices can detect a gesture and provide an appropriate response. Traditional gesture-recognition techniques are complex and may be ineffective at recognizing gestures in situations where variability may exist. For example, such systems may have difficulty detecting gestures from different users, from different viewpoints, due to external conditions, and/or the like.

SUMMARY

[0004] Aspects and advantages of embodiments of the present disclosure will be set forth in part in the following description, or can be learned from the description, or can be learned through practice of the embodiments.

[0005] One example aspect of the present disclosure is directed to a computer-implemented method. The method can include receiving, by one or more computing devices and from one or more sensors, data describing one or more three-dimensional motions comprising a three-dimensional-human-gesture input. The method can also include generating, by the one or more computing devices and based at least in part on the data describing the one or more three-dimensional motions, two-dimensional data at least partially describing at least one motion of the one or more three-dimensional motions. The method can further include identifying, by the one or more computing devices and based at least in part on the two-dimensional data, the three-dimensional-human-gesture input.

[0006] Another example aspect of the present disclosure is directed to a system. The system can include one or more processors and a memory storing instructions that when executed by the one or more processors cause the system to perform operations. The operations can include generating, based at least in part on data describing one or more three-dimensional motions, two-dimensional data at least partially describing at least one motion of the one or more three-dimensional motions. The operations can also include identifying, based at least in part on the two-dimensional data, a three-dimensional-human-gesture input within the one or more three-dimensional motions.

[0007] A further example aspect of the present disclosure is directed to one or more non-transitory computer-readable media. The one or more non-transitory computer-readable media can comprise instructions that when executed by one or more computing devices cause the one or more computing devices to perform operations. The operations can include projecting, onto a two-dimensional plane, a representation of at least a portion of data describing one or more three-dimensional motions comprising a three-dimensional-human-gesture input. The operations can also include identifying, based at least in part on the representation, the three-dimensional-human-gesture input.

[0008] Other aspects of the present disclosure are directed to various systems, apparatuses, non-transitory computer-readable media, user interfaces, and electronic devices.

[0009] These and other features, aspects, and advantages of various embodiments of the present disclosure will become better understood with reference to the following description and appended claims. The accompanying drawings, which are incorporated in and constitute a part of this specification, illustrate example embodiments of the present disclosure and, together with the description, serve to explain the related principles.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010] Detailed discussion of embodiments directed to one of ordinary skill in the art is set forth in the specification, which makes reference to the appended figures, in which:

[0011] **FIG. 1** depicts an example computing environment according to example embodiments of the present disclosure;

[0012] **FIGs. 2A-D** depict example event sequences according to example embodiments of the present disclosure;

[0013] **FIGs. 3-5** depict example scenes according to example embodiments of the present disclosure; and

[0014] **FIG. 6** depicts an example method according to example embodiments of the present disclosure.

DETAILED DESCRIPTION

[0015] Example aspects of the present disclosure are directed to identifying three-dimensional-human-gesture input. For example, one or more computing devices can receive (e.g., from one or more sensors, and/or the like), data (e.g., three-dimensional data, and/or the like) describing one or more three-dimensional motions (e.g., of a user, object manipulated by such user, and/or the like) comprising a three-dimensional-human-gesture input. Based at least in part on the data describing the three-dimensional motion(s), the computing device(s) can generate two-dimensional data at least partially describing at least one motion of the three-dimensional motion(s). For example, in some embodiments, the computing device(s) can project a representation of at least a portion of the data describing the three-dimensional motion(s) onto a two-dimensional plane defined by each dimension of the two-dimensional data. Based at least in part on the two-dimensional data, the computing device(s) can identify the three-dimensional-human-gesture input.

[0016] The technology described herein can provide a number of technical effects and benefits, particularly in the area of computer technology. For example, the technology described herein can enable three-dimensional human-based inputs to be interpreted by computer systems using less complex two-dimensional-input-recognition techniques. The technology can provide for a conversion of three-dimensional input data to two-dimensional data that can be readily interpreted by computing systems. In this manner, suitable computing devices can be configured to interpret three-dimensional input data using two-dimensional recognition techniques. Additionally, the use of sensors that generate three-dimensional data can enable accurate detections of movements in three-dimensional space. Moreover, converting such data to two-dimensional data prior to gesture recognition can enable a processor to more accurately and easily interpret input data. Additionally, the technology described herein may enable certain computing devices that might otherwise been unable to do so (e.g., due to limited resources, and/or the like) to interpret three-dimensional human-based inputs within an appropriate response time, and/or the like.

[0017] With reference now to the Figures, example embodiments of the present disclosure will be discussed in further detail.

[0018] **FIG. 1** depicts an example computing environment according to example embodiments of the present disclosure.

[0019] Referring to **FIG. 1**, environment **100** can include one or more computing devices (e.g., one or more desktop computers, laptop computers, tablet computers, mobile devices, smartphones, servers, appliances, wearable devices, personal digital assistants, Internet of Things (IoT) devices, peripherals, user-input devices, and/or the like). For example, environment **100** can include computing devices **10**, **20**, **30**, **40**, **50**, **60**, and/or **70**. In some embodiments, computing devices **10**, **20**, **30**, **40**, **50**, **60**, and/or **70** can be physically distinct from one another. Environment **100** can also include one or more networks **102** (e.g., one or more wired networks, wireless networks, and/or the like). Network(s) **102** can interface computing devices **10**, **20**, **30**, **40**, **50**, **60**, and/or **70** with one another.

[0020] Computing device **10** can include circuitry **104**, which can comprise one or more processor(s) **106**, one or more sensors **108**, one or more communication interfaces **110**, and memory **112** (e.g., one or more hardware components for storing executable instructions, data, and/or the like). Sensor(s) **108** can be configured to identify, describe, indicate, perceive, determine, and/or the like one or more variables, conditions, parameters, and/or the like of an environment of computing device **10**. For example, sensor(s) **108** can include one or more global positioning system (GPS) receivers, wireless-network interfaces, altimeters, proximity sensors, ambient-light sensors, accelerometers, gyroscopes, compasses, barometers, cameras, inertial measurement unit (IMU) sensors, ultrasound sensors, radar sensors, and/or the like. Communication interface(s) **110** can enable computing device **10** to communicate with computing devices **20**, **30**, **40**, **50**, **60**, and/or **70**. Memory **112** can include (e.g., store, and/or the like) instructions **114**. When executed by processor(s) **106**, instructions **114** can cause computing device **10** to perform one or more operations, functions, and/or the like described herein. It will be appreciated that computing devices **20**,

30, **40**, **50**, **60**, and/or **70** can include one or more of the components described above with respect to computing device **10**.

[0021] Unless explicitly indicated otherwise, the operations, functions, and/or the like described herein can be performed by computing devices **10**, **20**, **30**, **40**, **50**, **60**, and/or **70** (e.g., by one of computing devices **10**, **20**, **30**, **40**, **50**, **60**, or **70**, by a combination of one or more of computing devices **10**, **20**, **30**, **40**, **50**, **60**, and/or **70**, and/or the like).

[0022] **FIGs. 2A-D** depict example event sequences according to example embodiments of the present disclosure.

[0023] Referring to **FIG. 2A**, at (**202**), a user can be prompted to provide one or more three-dimensional-human-gesture inputs. For example, at (**202A**), computing device **10** can prompt a user of computing devices **10**, **20**, **30**, **40**, **50**, **60**, and/or **70** to provide one or more three-dimensional-human-gesture inputs. Additionally or alternatively, at (**202B**), computing device **20** can prompt the user of computing devices **10**, **20**, **30**, **40**, **50**, **60**, and/or **70** to provide one or more three-dimensional-human-gesture inputs.

[0024] For example, **FIG. 3** depicts an example scene according to example embodiments of the present disclosure. Referring to **FIG. 3**, scene **300** can include objects **302** and/or **304**. A user can utilize object **302** (e.g., the user's hand, and/or the like) to hold object **304** (e.g., a magic wand, and/or the like). Object **304** can include computing device **20**. Scene **300** can also include computing device **10**. Computing device **10** can include sensors **108A**, **108B**, and/or **108C**, which can, for example, be configured to monitor, track, and/or the like movements, positions, and/or the like of objects **302** and/or **304**. Computing device **10** can include display device **310** for presenting one or more graphical interfaces for viewing by the user.

[0025] In some embodiments, the user can be prompted by computing device **10** to provide the three-dimensional-human-gesture input(s). For example, computing device **10** can generate data describing one or more graphical interfaces including one or more elements prompting the user to provide the three-dimensional-human-gesture input(s) and can communicate such data to display device **310**, which can render the graphical interface(s) for viewing by the user, and/or the like. Additionally or alternatively, the user can be prompted by computing device **20** to provide the three-dimensional-human-gesture input(s). For example, computing device **20** can generate motion of object **304** (e.g., haptic feedback, and/or the like), which can prompt the user to provide the three-dimensional-human-gesture input(s).

[0026] The user can be prompted, for example, to provide one or more three-dimensional-human-gesture inputs characterized by manipulating, moving, repositioning, tilting, and/or the like object **304** (e.g., the tip of the wand, and/or the like) in accordance with trajectory **308** (e.g., from position **306A** to position **306B**, from position **306B** to position **306C**, and/or the like).

[0027] Returning to **FIG. 2A**, at (**204**), data describing one or more inputs to computing devices **10** and/or **20** can be received. The data can include data describing one or more three-dimensional motions (e.g., x coordinates, y coordinates, z coordinates, corresponding time stamps, and/or the like) comprising the three-dimensional-human-gesture input(s) (e.g., characterized by manipulating, moving, repositioning, tilting, and/or the like object **304** in accordance with trajectory **308**, and/or the like). For example, at (**204A**), computing device **10** can receive data from sensors **108A**, **108B**, and/or **108C** (e.g., one or more cameras, and/or the like) describing one or more three-dimensional motions of scene **300** (e.g., with respect to objects **302**, **304**, and/or the like) comprising the three-dimensional-human-gesture input(s). Additionally or alternatively, at (**204B**), computing device **20** can receive data from one or more sensors of computing device **20** (e.g., one or more IMU sensors, and/or the like) describing one or more three-dimensional motions of scene **300** (e.g., with respect to object **304**, and/or the like) comprising the three-dimensional-human-gesture input(s). For example, the user (e.g., in response to the prompt(s), and/or the like) can have taken one or more actions (e.g., characterized by manipulating, moving, repositioning, tilting, and/or the like object **304** in accordance with trajectory **308**, and/or the like) corresponding to the three-dimensional-human-gesture input(s), and computing devices **10** and/or **20** can receive data describing the three-dimensional motion(s) of scene **300**, which can include the action(s) of the user.

[0028] At (**206**), computing device **10** can communicate (e.g., via network(s) **102**, and/or the like) the data describing the three-dimensional motion(s) of scene **300** (e.g., the data received at (**204A**), and/or the like) to computing device **20**. Similarly, at (**208**), computing device **20** can communicate (e.g., via network(s) **102**, and/or the like) the data describing the three-dimensional motion(s) of scene **300** (e.g., the data received at (**204B**), and/or the like) to computing device **10**. At (**210**), data describing the three-dimensional motion(s) can be received. For example, at (**210A**), computing device **10** can receive the data describing the three-dimensional motion(s) of scene **300** from computing device **20**. Additionally or alternatively, at (**210B**), computing device **20** can receive the data describing the three-dimensional motion(s) of scene **300** from computing device **10**.

[0029] At (**212**), two-dimensional data (e.g., x coordinates, y coordinates, corresponding time stamps, and/or the like) at least partially describing the three-dimensional motion(s) can be generated. For example, at (**212A**), computing device **10** can generate, for example, based at least in part on the data describing the three-dimensional motion(s) of scene **300** (e.g., the data received at (**204A**), (**210A**), and/or the like), two-dimensional data at least partially describing the three-dimensional motion(s) of scene **300**. Additionally or alternatively, at (**212B**), computing device **20** can generate, for example, based at least in part on the data describing the three-dimensional motion(s) of scene **300** (e.g., the data received at (**204B**), (**210B**), and/or the like), two-dimensional data at least partially describing the three-dimensional motion(s) of scene **300**. In some embodiments, generating the two-dimensional data can include projecting a representation of at least a portion of the data describing the three-dimensional motion(s) onto a two-dimensional plane defined by each dimension of the two-dimensional data.

[0030] At (**214**), computing device **10** can communicate (e.g., via network(s) **102**, and/or the like) the two-dimensional data at least partially describing the three-dimensional motion(s) of scene **300** (e.g., the data generated at (**212A**), and/or the like) to computing device **20**. Similarly, at (**216**), computing device **20** can communicate (e.g., via network(s) **102**, and/or the like) the two-dimensional data at least partially describing the three-dimensional motion(s) of scene **300** (e.g., the data generated at (**212B**), and/or the like) to computing device **10**.

[0031] At (**218**), computing device **10** can display one or more graphical interfaces comprising one or more elements depicting a representation of at least a portion of the data describing the three-dimensional motion(s) of scene **300**. For example, referring to **FIG. 3**, computing device **10** can generate data describing one or more graphical interfaces **312** and can communicate such data to display device **310** for viewing by the user. Graphical interface(s) **312** can include one or more elements **314** depicting a representation of at least a portion of the data describing the three-dimensional motion(s) of scene **300**. For example, as indicated above, in some embodiments, generating the two-dimensional data can include projecting a representation of at least a portion of the data describing the three-dimensional motion(s) onto a two-dimensional plane defined by each dimension of the two-dimensional data. In some of such embodiments, element(s) **314** can depict such a representation (e.g., a two-dimensional rendering of trajectory **308**, and/or the like).

[0032] Returning to **FIG. 2A**, at (**220**), one or more objects included in the three-dimensional motion(s) can be identified. For example, at (**220A**), computing device **10** can identify, for example, based at least in part on the data describing the three-dimensional motion(s) of scene **300** (e.g., the data received at (**204A**), (**204B**), and/or the like), objects **302** and/or **304** within the three-dimensional motion(s) of scene **300**. Additionally or alternatively, at (**220B**), computing device **20** can identify, for example, based at least in part on the data describing the three-dimensional motion(s) of scene **300** (e.g., the data received at (**204A**), (**204B**), and/or the like), objects **302** and/or **304** within the three-dimensional motion(s) of scene **300**. In some embodiments, such object(s) can be identified from amongst a plurality of different predefined, distinct objects associated with a plurality of different predefined, distinct three-dimensional-human-gesture inputs.

[0033] At (**222**), the three-dimensional-human-gesture input(s) can be identified based at least in part on the two-dimensional data. For example, at (**222A**), computing device **10** can identify the three-dimensional-human-gesture input(s) (e.g., characterized by manipulating, moving, repositioning, tilting, and/or the like object **304** in accordance with trajectory **308**, and/or the like) based at least in part on the two-dimensional data generated at (**212A**), (**212B**), and/or the like. Additionally or alternatively, at (**222B**), computing device **20** can identify the three-dimensional-human-gesture input(s) (e.g., characterized by manipulating, moving, repositioning, tilting, and/or the like object **304** in accordance with trajectory **308**, and/or the like) based at least in part on the two-dimensional data generated at (**212A**), (**212B**), and/or the like.

[0034] In some embodiments, computing devices **10** and/or **20** can store data describing a plurality of different predefined, distinct three-dimensional-human-gesture inputs. Such data can include, for each particular three-dimensional-human-gesture input of the plurality of different predefined, distinct three-dimensional-human-gesture inputs, two-dimensional data describing one or more three-dimensional motions associated with the particular three-dimensional-human-gesture input. In some of such embodiments, computing devices **10** and/or **20** can identify the three-dimensional-human-gesture input(s) from amongst the plurality of different predefined, distinct three-dimensional-human-gesture inputs based at least in part on a correspondence between: at least a portion of the two-dimensional data at least partially describing the three-dimensional motion(s), and at least a portion of the data describing the plurality of different predefined, distinct three-dimensional-human-gesture inputs. In some embodiments, the portion of the data describing the plurality of different predefined, distinct three-dimensional-human-gesture inputs can be identified based at least in part on the identified object(s) included in the three-dimensional motion(s) (e.g., a search for corresponding data can be narrowed to data describing inputs associated with such object(s), and/or the like). In some embodiments, identifying the three-dimensional-human-gesture input(s) can include utilizing one or more two-dimensional-movement-recognition models (e.g., stroke-recognition algorithms, character-recognition algorithms, handwriting-recognition algorithms, and/or the like) to analyze at least a portion of the two-dimensional data (e.g., to identify one or more two-dimensional movements corresponding to the three-dimensional-human-gesture input(s), and/or the like). In some of such embodiments, one or more of such two-dimensional-movement-recognition model(s) can be preexisting (e.g., need not be reconfigured to identify the two-dimensional movement(s), and/or the like).

[0035] Responsive to identifying the three-dimensional-human-gesture input(s), at (**224**), one or more functions associated with the three-dimensional-human-gesture input(s) can be identified and invoked. For example, the three-dimensional-human-gesture input(s) (e.g., characterized by manipulating, moving, repositioning, tilting, and/or the like object **304** in accordance with trajectory **308**, and/or the like) can be associated with one or more functions (e.g., casting a spell, and/or the like), for example, associated with an application (e.g., a game, and/or the like), and responsive to identifying the input(s), at (**224A**), computing device **10** can identify and invoke the associated function(s). Additionally or alternatively, responsive to identifying the input(s), at (**224B**), computing device **20** can identify and invoke the associated function(s).

[0036] **FIG. 4** depicts an example scene according to example embodiments of the present disclosure. Referring to **FIG. 4**, scene **400** can include object **402** (e.g., a coffee cup, and/or the like). Object **402** can include computing device **30**. Scene **400** can also include computing devices **10**, **40**, and/or **50**. Computing devices **10**, **30**, **40**, and/or **50** can be of different types (e.g., computing device **30** can be a computing device comprising an IMU sensor embedded in a coffee cup, computing device **40** can be an audio-controlled personal-assistant device, computing device **50** can be a smart-appliance coffee maker, and/or the like). Computing device **40** can include sensor **406** (e.g., a microphone, and/or the like). Computing device **50** can include sensor **408** (e.g., configured to determine one or more statuses of the coffee maker, and/or the like).

[0037] One or more three-dimensional-human-gesture inputs can be characterized by manipulating, moving, repositioning, tilting, and/or the like object **402** (e.g., from position **404A** to position **404B**, from position **404B** to position **404C**, from position **404C** to position **404D**, and/or the like). For example, a three-dimensional-human-gesture input (e.g., associated with lifting a coffee cup, and/or the like) can be characterized by manipulating, moving, repositioning, tilting, and/or the like object **402** from position **404A** to position **404B**, and/or the like. Additionally or alternatively, a different three-dimensional-human-gesture input (e.g., associated with an empty coffee cup, and/or the like) can be characterized by manipulating, moving, repositioning, tilting, and/or the like object **402** from position **404C** to position **404D**, and/or the like.

[0038] The three-dimensional-human-gesture input (e.g., associated with lifting the coffee cup, and/or the like) characterized by manipulating, moving, repositioning, tilting, and/or the like object **402** from position **404A** to position **404B**, and/or the like can be associated with a function of computing device **40** (e.g., signaling the user has begun their morning routine, it is time for computing device **40** to read aloud the latest news updates, and/or the like). Similarly, the three-dimensional-human-gesture input (e.g., associated with an empty coffee cup, and/or the like) characterized by manipulating, moving, repositioning, tilting, and/or the like object **402** from position **404C** to position **404D**, and/or the like can be associated with a function of computing device **50** (e.g., signaling the user may desire additional coffee, computing device **50** should utilize sensor **408** to determine whether it should brew additional coffee, and/or the like).

[0039] Referring to **FIG. 2B**, at (**226**), data describing one or more inputs to computing devices **10**, **30**, **40**, and/or **50** can be received. The data can include data describing one or more three-dimensional motions (e.g., x coordinates, y coordinates, z coordinates, corresponding time stamps, and/or the like) comprising one or more three-dimensional-human-gesture inputs (e.g., characterized by manipulating, moving, repositioning, tilting, and/or the like object **402**, and/or the like). For example, at (**226A**), computing device **10** can receive data from sensors **108A**, **108B**, and/or **108C** (e.g., one or more cameras, and/or the like) describing one or more three-dimensional motions of scene **400** (e.g., with respect to object **402**, and/or the like) comprising the three-dimensional-human-gesture input(s). Additionally or alternatively, at (**226B**), computing device **30** can receive data from one or more sensors of computing device **30** (e.g., one or more IMU sensors, and/or the like) describing one or more three-dimensional motions of scene **400** (e.g., with respect to object **402**, and/or the like) comprising the three-dimensional-human-gesture input(s). Additionally or alternatively, at (**226C**), computing device **40** can receive data from one or more sensors of computing device **40** (e.g., a microphone, and/or the like). Additionally or alternatively, at (**226D**), computing device **50** can receive data from one or more sensors of computing device **50** (e.g., configured to determine one or more statuses of the coffee maker, and/or the like).

[0040] At (**228**), computing device **10** can communicate (e.g., via network(s) **102**, and/or the like) data describing one or more of the input(s) associated with scene **400** (e.g., the data received at (**226A**), and/or the like) to computing device **30** (e.g., at (**228A**), and/or the like), computing device **40** (e.g., at (**228B**), and/or the like), and/or computing device **50** (e.g., at (**228C**), and/or the like). Similarly, at (**230**), computing device **30** can communicate (e.g., via network(s) **102**, and/or the like) data describing one or more of the input(s) associated with scene **400** (e.g., the data received at (**226B**), and/or the like) to computing device **10** (e.g., at (**230A**), and/or the like), computing device **40** (e.g., at (**230B**), and/or the like), and/or computing device **50** (e.g., at (**230C**), and/or the like); at (**232**), computing device **40** can communicate (e.g., via network(s) **102**, and/or the like) data describing one or more of the input(s) associated with scene **400** (e.g., the data received at (**226C**), and/or the like) to computing device **10** (e.g., at (**232A**), and/or the like), computing device **30** (e.g., at (**232B**), and/or the like), and/or computing device **50** (e.g., at (**232C**), and/or the like); and, at (**234**), computing device **50** can communicate (e.g., via network(s) **102**, and/or the like) data describing one or more of the input(s) associated with scene **400** (e.g., the data received at (**226D**), and/or the like) to computing device **10** (e.g., at (**234A**), and/or the like), computing device **30** (e.g., at (**234B**), and/or the like), and/or computing device **40** (e.g., at (**234C**), and/or the like).

[0041] At (**236**), data describing the three-dimensional motion(s) can be received. For example, at (**236A**), computing device **10** can receive data describing the three-dimensional motion(s) of scene **400** from computing device(s) **30**, **40**, and/or **50**. Additionally or alternatively, at (**236B**), computing device **30** can receive data describing the three-dimensional motion(s) of scene **400** from computing device(s) **10**, **40**, and/or **50**. Additionally or alternatively, at (**236C**), computing device **40** can receive data describing the three-dimensional motion(s) of scene **400** from computing device(s) **10**, **30**, and/or **50**. Additionally or alternatively, at (**236D**), computing device **50** can receive data describing the three-dimensional motion(s) of scene **400** from computing device(s) **10**, **30**, and/or **40**.

[0042] At (**238**), two-dimensional data (e.g., x coordinates, y coordinates, corresponding time stamps, and/or the like) at least partially describing the three-dimensional motion(s) can be generated. For example, at (**238A**), computing device **10** can generate, for example, based at least in part on the data describing the three-dimensional motion(s) of scene **400** (e.g., the data received at (**226A**), (**236A**), and/or the like), two-dimensional data at least partially describing the three-dimensional motion(s) of scene **400**. Additionally or alternatively, at (**238B**), computing device **30** can generate, for example, based at least in part on the data describing the three-dimensional motion(s) of scene **400** (e.g., the data received at (**226B**), (**236B**), and/or the like), two-dimensional data at least partially describing the three-dimensional motion(s) of scene **400**. Additionally or alternatively, at (**238C**), computing device **40** can generate, for example, based at least in part on the data describing the three-dimensional motion(s) of scene **400** (e.g., the data received at (**226C**), (**236C**), and/or the like), two-dimensional data at least partially describing the three-dimensional motion(s) of scene **400**. Additionally or alternatively, at (**238D**), computing device **50** can generate, for example, based at least in part on the data describing the three-dimensional motion(s) of scene **400** (e.g., the data received at (**226D**), (**236D**), and/or the like), two-dimensional data at least partially describing the three-dimensional motion(s) of scene **400**.

[0043] At (**240**), computing device **10** can communicate (e.g., via network(s) **102**, and/or the like) the two-dimensional data at least partially describing the three-dimensional motion(s) of scene **400** (e.g., the data generated at (**238A**), and/or the like) to computing device **30** (e.g., at (**240A**), and/or the like), computing device **40** (e.g., at (**240B**), and/or the like), and/or computing device **50** (e.g., at (**240C**), and/or the like). Similarly, at (**242**), computing device **30** can communicate (e.g., via network(s) **102**, and/or the like) the two-dimensional data at least partially describing the three-dimensional motion(s) of scene **400** (e.g., the data generated at (**238B**), and/or the like) to computing device **10** (e.g., at (**242A**), and/or the like), computing device **40** (e.g., at (**242B**), and/or the like), and/or computing device **50** (e.g., at (**242C**), and/or the like); at (**244**), computing device **40** can communicate (e.g., via network(s) **102**, and/or the like) the two-dimensional data at least partially describing the three-dimensional motion(s) of scene **400** (e.g., the data generated at (**238C**), and/or the like) to computing device **10** (e.g., at (**244A**), and/or the like), computing device

30 (e.g., at (**244B**), and/or the like), and/or computing device **50** (e.g., at (**244C**), and/or the like); and, at (**246**), computing device **50** can communicate (e.g., via network(s) **102**, and/or the like) the two-dimensional data at least partially describing the three-dimensional motion(s) of scene **400** (e.g., the data generated at (**238D**), and/or the like) to computing device **10** (e.g., at (**246A**), and/or the like), computing device **30** (e.g., at (**246B**), and/or the like), and/or computing device **40** (e.g., at (**246C**), and/or the like).

[0044] At (**248**), one or more objects included in the three-dimensional motion(s) can be identified. For example, at (**248A**), computing device **10** can identify, for example, based at least in part on the data describing the three-dimensional motion(s) of scene **400** (e.g., the data received at (**226A**), (**226B**), (**226C**), (**226D**), and/or the like), object **402** within the three-dimensional motion(s) of scene **400**. Additionally or alternatively, at (**248B**), computing device **30** can identify, for example, based at least in part on the data describing the three-dimensional motion(s) of scene **400** (e.g., the data received at (**226A**), (**226B**), (**226C**), (**226D**), and/or the like), object **402** within the three-dimensional motion(s) of scene **400**. Additionally or alternatively, at (**248C**), computing device **40** can identify, for example, based at least in part on the data describing the three-dimensional motion(s) of scene **400** (e.g., the data received at (**226A**), (**226B**), (**226C**), (**226D**), and/or the like), object **402** within the three-dimensional motion(s) of scene **400**. Additionally or alternatively, at (**248D**), computing device **50** can identify, for example, based at least in part on the data describing the three-dimensional motion(s) of scene **400** (e.g., the data received at (**226A**), (**226B**), (**226C**), (**226D**), and/or the like), object **402** within the three-dimensional motion(s) of scene **400**.

[0045] Referring to **FIG. 2C**, at (**250**), the three-dimensional-human-gesture input(s) can be identified based at least in part on the two-dimensional data. For example, at (**250A**), computing device **10** can identify the three-dimensional-human-gesture input(s) (e.g., characterized by manipulating, moving, repositioning, tilting, and/or the like object **402**, and/or the like) based at least in part on the two-dimensional data generated at (**238A**), (**238B**), (**238C**), (**238D**), and/or the like. Additionally or alternatively, at (**250B**), computing device **30** can identify the three-dimensional-human-gesture input(s) (e.g., characterized by manipulating, moving, repositioning, tilting, and/or the like object **402**, and/or the like) based at least in part on the two-dimensional data generated at (**238A**), (**238B**), (**238C**), (**238D**), and/or the like. Additionally or alternatively, at (**250C**), computing device **40** can identify the three-dimensional-human-gesture input(s) (e.g., characterized by manipulating, moving, repositioning, tilting, and/or the like object **402**, and/or the like) based at least in part on the two-dimensional data generated at **(238A)**, **(238B)**, **(238C)**, **(238D)**, and/or the like. Additionally or alternatively, at **(250D)**, computing device **50** can identify the three-dimensional-human-gesture input(s) (e.g., characterized by manipulating, moving, repositioning, tilting, and/or the like object **402**, and/or the like) based at least in part on the two-dimensional data generated at **(238A)**, **(238B)**, **(238C)**, **(238D)**, and/or the like.

[0046] Responsive to identifying the three-dimensional-human-gesture input(s), at **(252)**, one or more functions associated with the three-dimensional-human-gesture input(s) can be identified and invoked. For example, the three-dimensional-human-gesture input(s) (e.g., characterized by manipulating, moving, repositioning, tilting, and/or the like object **402**, and/or the like) can be associated with one or more functions (e.g., signaling the user has begun their morning routine, it is time for computing device **40** to read aloud the latest news updates, signaling the user may desire additional coffee, computing device **50** should utilize sensor **408** to determine whether it should brew additional coffee, and/or the like), and responsive to identifying the input(s), at **(252A)**, computing device **10** can identify and invoke the associated function(s). Additionally or alternatively, responsive to identifying the input(s), at **(252B)**, computing device **30** can identify and invoke the associated function(s). Additionally or alternatively, responsive to identifying the input(s), at **(252C)**, computing device **40** can identify and invoke the associated function(s). Additionally or alternatively, responsive to identifying the input(s), at **(252D)**, computing device **50** can identify and invoke the associated function(s).

[0047] **FIG. 5** depicts an example scene according to example embodiments of the present disclosure. Referring to **FIG. 5**, scene **500** can include object **502** (e.g., an hourglass, and/or the like). Object **502** can include computing device **60**. Scene **500** can also include computing devices **10**, **40**, **50**, and/or **70**. Computing device **70** can include sensor **506** (e.g., an accelerometer, and/or the like).

[0048] One or more three-dimensional-human-gesture inputs can be characterized by manipulating, moving, repositioning, tilting, and/or the like object **502** (e.g., from position **504A** to position **504B**, from position **504B** to position **504C**, and/or the like). The three-dimensional-human-gesture input (e.g., associated with flipping the hourglass, and/or the like) characterized by manipulating, moving, repositioning, tilting, and/or the like object **502** from position **504A** to position **504B**, from position **504B** to position **504C**, and/or the like can be associated with multiple different functions. For example, the input can be associated with starting a timer of computing device **70** (e.g., the timer depicted by elements **510A** and **510B** of graphical interface **508** displayed by computing device **70**, and/or the like), starting a timer of computing device **50**, and/or the like.

[0049] Returning to **FIG. 2C**, at (**254**), data describing one or more inputs to computing devices **10**, **40**, **50**, **60**, and/or **70** can be received. The data can include data describing one or more three-dimensional motions (e.g., x coordinates, y coordinates, z coordinates, corresponding time stamps, and/or the like) comprising one or more three-dimensional-human-gesture inputs (e.g., characterized by manipulating, moving, repositioning, tilting, and/or the like object **502**, and/or the like). For example, at (**254A**), computing device **10** can receive data from sensors **108A**, **108B**, and/or **108C** (e.g., one or more cameras, and/or the like) describing one or more three-dimensional motions of scene **500** (e.g., with respect to object **502**, and/or the like) comprising the three-dimensional-human-gesture input(s). Additionally or alternatively, at (**254B**), computing device **40** can receive data from one or more sensors of computing device **40** (e.g., a microphone, and/or the like). Additionally or alternatively, at (**254C**), computing device **50** can receive data from one or more sensors of computing device **50** (e.g., configured to determine one or more statuses of the coffee maker, and/or the like). Additionally or alternatively, at (**254D**), computing device **60** can receive data from one or more sensors of computing device **60** (e.g., one or more IMU sensors, and/or the like) describing one or more three-dimensional motions of scene **500** (e.g., with respect to object **502**, and/or the like) comprising the three-dimensional-human-gesture input(s). Additionally or alternatively, at (**254E**), computing device **70** can receive data from one or more sensors of computing device **70**.

[0050] At (**256**), computing device **10** can communicate (e.g., via network(s) **102**, and/or the like) data describing one or more of the input(s) associated with scene **500** (e.g., the data received at (**254A**), and/or the like) to computing device **40** (e.g., at (**256A**), and/or the like), computing device **50** (e.g., at (**256B**), and/or the like), computing device **60** (e.g., at (**256C**), and/or the like), and/or computing device **70** (e.g., at (**256D**), and/or the like). Similarly, at (**258**), computing device **40** can communicate (e.g., via network(s) **102**, and/or the like) data describing one or more of the input(s) associated with scene **500** (e.g., the data received at (**254B**), and/or the like) to computing device **10** (e.g., at (**258A**), and/or the like), computing device **50** (e.g., at (**258B**), and/or the like), computing device **60** (e.g., at (**258C**), and/or the like), and/or computing device **70** (e.g., at (**258D**), and/or the like); at (**260**), computing device **50** can communicate (e.g., via network(s) **102**, and/or the like) data describing one or more of the input(s) associated with scene **500** (e.g., the data received at (**254C**), and/or the like) to computing device **10** (e.g., at (**260A**), and/or the like), computing device **40** (e.g., at (**260B**), and/or the like), computing device **60** (e.g., at (**260C**), and/or the like), and/or computing device **70** (e.g., at (**260D**), and/or the like); at (**262**), computing device **60** can communicate (e.g., via network(s) **102**, and/or the like) data describing one or more of the input(s) associated with scene **500** (e.g., the data received at (**254D**), and/or the like) to computing device **10** (e.g., at (**262A**), and/or the like), computing device **40** (e.g., at (**262B**), and/or the like), computing device **50** (e.g., at (**262C**), and/or the like), and/or computing device **70** (e.g., at (**262D**), and/or the like); and, at (**264**), computing device **70** can communicate (e.g., via network(s) **102**, and/or the like) data describing one or more of the input(s) associated with scene **500** (e.g., the data received at (**254E**), and/or the like) to computing device **10** (e.g., at (**264A**), and/or the like), computing device **40** (e.g., at (**264B**), and/or the like), computing device **50** (e.g., at (**264C**), and/or the like), and/or computing device **60** (e.g., at (**264D**), and/or the like).

[0051] At (**266**), data describing the three-dimensional motion(s) can be received. For example, at (**266A**), computing device **10** can receive data describing the three-dimensional motion(s) of scene **500** from computing device(s) **40**, **50**, **60**, and/or **70**. Additionally or alternatively, at (**266B**), computing device **40** can receive data describing the three-dimensional motion(s) of scene **500** from computing device(s) **10**, **50**, **60**, and/or **70**. Additionally or alternatively, at (**266C**), computing device **50** can receive data describing the three-dimensional motion(s) of scene **500** from computing device(s) **10**, **40**, **60**, and/or **70**. Additionally or alternatively, at (**266D**), computing device **60** can receive data describing the three-dimensional motion(s) of scene **500** from computing device(s) **10**, **40**, **50**, and/or **70**. Additionally or alternatively, at (**266E**), computing device **70** can receive data describing the three-dimensional motion(s) of scene **500** from computing device(s) **10**, **40**, **50**, and/or **60**.

[0052] At (**268**), two-dimensional data (e.g., x coordinates, y coordinates, corresponding time stamps, and/or the like) at least partially describing the three-dimensional motion(s) can be generated. For example, at (**268A**), computing device **10** can generate, for example, based at least in part on the data describing the three-dimensional motion(s) of scene **500** (e.g., the data received at (**254A**), (**266A**), and/or the like), two-dimensional data at least partially describing the three-dimensional motion(s) of scene **500**. Additionally or alternatively, at (**268B**), computing device **40** can generate, for example, based at least in part on the data describing the three-dimensional motion(s) of scene **500** (e.g., the data received at (**254B**), (**266B**), and/or the like), two-dimensional data at least partially describing the three-dimensional motion(s) of scene **500**. Additionally or alternatively, at (**268C**), computing device **50** can generate, for example, based at least in part on the data describing the three-dimensional motion(s) of scene **500** (e.g., the data received at (**254C**), (**266C**), and/or the like), two-dimensional data at least partially describing the three-dimensional motion(s) of scene **500**. Additionally or alternatively, at (**268D**), computing device **60** can generate, for example, based at least in part on the data describing the three-dimensional motion(s) of scene **500** (e.g., the data received at (**254D**), (**266D**), and/or the like), two-dimensional data at least partially describing the three-dimensional motion(s) of scene **500**. Additionally or alternatively, at (**268E**), computing device **70** can generate, for example, based at least in part on the data describing the three-dimensional motion(s) of scene **500** (e.g., the data received at (**254E**), (**266E**), and/or the like), two-dimensional data at least partially describing the three-dimensional motion(s) of scene **500**.

[0053] At (**270**), computing device **10** can communicate (e.g., via network(s) **102**, and/or the like) the two-dimensional data at least partially describing the three-dimensional motion(s) of scene **500** (e.g., the data generated at (**268A**), and/or the like) to computing device **40** (e.g., at (**270A**), and/or the like), computing device **50** (e.g., at (**270B**), and/or the like), computing device **60** (e.g., at (**270C**), and/or the like), and/or computing device **70** (e.g., at (**270D**), and/or the like). Similarly, at (**272**), computing device **40** can communicate (e.g., via network(s) **102**, and/or the like) the two-dimensional data at least partially describing the three-dimensional motion(s) of scene **500** (e.g., the data generated at (**268B**), and/or the like) to computing device **10** (e.g., at (**272A**), and/or the like), computing device **50** (e.g., at (**272B**), and/or the like), computing device **60** (e.g., at (**272C**), and/or the like), and/or computing device **70** (e.g., at (**272D**), and/or the like); referring to **FIG. 2D**, at (**274**), computing device **50** can communicate (e.g., via network(s) **102**, and/or the like) the two-dimensional data at least partially describing the three-dimensional motion(s) of scene **500** (e.g., the data generated at (**268C**), and/or the like) to computing device **10** (e.g., at (**274A**), and/or the like), computing device **40** (e.g., at (**274B**), and/or the like), computing device **60** (e.g., at (**274C**), and/or the like), and/or computing device **70** (e.g., at (**274D**), and/or the like); at (**276**), computing device **60** can communicate (e.g., via network(s) **102**, and/or the like) the two-dimensional data at least partially describing the three-dimensional motion(s) of scene **500** (e.g., the data generated at (**268D**), and/or the like) to computing device **10** (e.g., at

(**276A**), and/or the like), computing device **40** (e.g., at (**276B**), and/or the like), computing device **50** (e.g., at (**276C**), and/or the like), and/or computing device **70** (e.g., at (**276D**), and/or the like); and, at (**278**), computing device **70** can communicate (e.g., via network(s) **102**, and/or the like) the two-dimensional data at least partially describing the three-dimensional motion(s) of scene **500** (e.g., the data generated at (**268E**), and/or the like) to computing device **10** (e.g., at (**278A**), and/or the like), computing device **40** (e.g., at (**278B**), and/or the like), computing device **50** (e.g., at (**278C**), and/or the like), and/or computing device **60** (e.g., at (**278D**), and/or the like).

[0054] At (**280**), one or more objects included in the three-dimensional motion(s) can be identified. For example, at (**280A**), computing device **10** can identify, for example, based at least in part on the data describing the three-dimensional motion(s) of scene **500** (e.g., the data received at (**254A**), (**254B**), (**254C**), (**254D**), (**254E**), and/or the like), object **502** within the three-dimensional motion(s) of scene **500**. Additionally or alternatively, at (**280B**), computing device **40** can identify, for example, based at least in part on the data describing the three-dimensional motion(s) of scene **500** (e.g., the data received at (**254A**), (**254B**), (**254C**), (**254D**), (**254E**), and/or the like), object **502** within the three-dimensional motion(s) of scene **500**. Additionally or alternatively, at (**280C**), computing device **50** can identify, for example, based at least in part on the data describing the three-dimensional motion(s) of scene **500** (e.g., the data received at (**254A**), (**254B**), (**254C**), (**254D**), (**254E**), and/or the like), object **502** within the three-dimensional motion(s) of scene **500**. Additionally or alternatively, at (**280D**), computing device **60** can identify, for example, based at least in part on the data describing the three-dimensional motion(s) of scene **500** (e.g., the data received at (**254A**), (**254B**), (**254C**), (**254D**), (**254E**), and/or the like), object **502** within the three-dimensional motion(s) of scene **500**. Additionally or alternatively, at (**280E**), computing device **70** can identify, for example, based at least in part on the data describing the three-dimensional motion(s) of scene **500** (e.g., the data received at (**254A**), (**254B**), (**254C**), (**254D**), (**254E**), and/or the like), object **502** within the three-dimensional motion(s) of scene **500**.

[0055] At (**282**), the three-dimensional-human-gesture input(s) can be identified based at least in part on the two-dimensional data. For example, at (**282A**), computing device **10** can identify the three-dimensional-human-gesture input(s) (e.g., characterized by manipulating, moving, repositioning, tilting, and/or the like object **502**, and/or the like) based at least in part on the two-dimensional data generated at (**268A**), (**268B**), (**268C**), (**268D**), (**268E**), and/or the like. Additionally or alternatively, at (**282B**), computing device **40** can identify the three-dimensional-human-gesture input(s) (e.g., characterized by manipulating, moving, repositioning, tilting, and/or the like object **502**, and/or the like) based at least in part on the two-dimensional data generated at (**268A**), (**268B**), (**268C**), (**268D**), (**268E**), and/or the like. Additionally or alternatively, at (**282C**), computing device **50** can identify the three-dimensional-human-gesture input(s) (e.g., characterized by manipulating, moving, repositioning, tilting, and/or the like object **502**, and/or the like) based at least in part on the two-dimensional data generated at (**268A**), (**268B**), (**268C**), (**268D**), (**268E**), and/or the like. Additionally or alternatively, at (**282D**), computing device **60** can identify the three-dimensional-human-gesture input(s) (e.g., characterized by manipulating, moving, repositioning, tilting, and/or the like object **502**, and/or the like) based at least in part on the two-dimensional data generated at (**268A**), (**268B**), (**268C**), (**268D**), (**268E**), and/or the like. Additionally or alternatively, at (**282E**), computing device **70** can identify the three-dimensional-human-gesture input(s) (e.g., characterized by manipulating, moving, repositioning, tilting, and/or the like object **502**, and/or the like) based at least in part on the two-dimensional data generated at (**268A**), (**268B**), (**268C**), (**268D**), (**268E**), and/or the like.

[0056] Responsive to identifying the three-dimensional-human-gesture input(s), at (**284**), one or more functions associated with the three-dimensional-human-gesture input(s) can be identified and invoked. For example, the three-dimensional-human-gesture input(s) (e.g., characterized by manipulating, moving, repositioning, tilting, and/or the like object **502**, and/or the like) can be associated with one or more functions (e.g., starting the timer of computing device **50**, starting the timer of computing device **70**, and/or the like), and responsive to identifying the input(s), at (**284A**), computing device **10** can identify and invoke the associated function(s). Additionally or alternatively, responsive to identifying the input(s), at (**284B**), computing device **40** can identify and invoke the associated function(s). Additionally or alternatively, responsive to identifying the input(s), at (**284C**), computing device **50** can identify and invoke the associated function(s). Additionally or alternatively, responsive to identifying the input(s), at (**284D**), computing device **60** can identify and invoke the associated function(s). Additionally or alternatively, responsive to identifying the input(s), at (**284E**), computing device **70** can identify and invoke the associated function(s).

[0057] **FIG. 6** depicts an example method according to example embodiments of the present disclosure.

[0058] Referring to **FIG. 6**, at (**602**), one or more computing devices can receive data describing one or more three-dimensional motions comprising a three-dimensional-human-gesture input (e.g., as described above with respect to (**210**), (**236**), (**266**), and/or the like). As previously indicated, in some embodiments, one or more of such three-dimensional motion(s) can include one or more three-dimensional motions of one or more objects (e.g., one or more body parts of a user, one or more objects manipulated by a user, and/or the like).

[0059] At (**604**), the computing device(s) can generate, based at least in part on the data describing the three-dimensional motion(s), two-dimensional data at least partially describing at least one motion of the three-dimensional motion(s) (e.g., as described above with respect to (**212**), (**238**), (**268**), and/or the like).

[0060] At (**606**), the computing device(s) can identify, based at least in part on the two-dimensional data, the three-dimensional-human-gesture input (e.g., as described above with respect to (**222**), (**250**), (**282**), and/or the like).

[0061] The technology discussed herein refers to servers, databases, software applications, and/or other computer-based systems, as well as actions taken and information sent to and/or from such systems. The inherent flexibility of computer-based systems allows for a great variety of possible configurations, combinations, and/or divisions of tasks and/or functionality between and/or among components. For instance, processes discussed herein can be implemented using a single device or component and/or multiple devices or components working in combination. Databases and/or applications can be implemented on a single system and/or distributed across multiple systems. Distributed components can operate sequentially and/or in parallel.

[0062] Various connections between elements are discussed in the above description. These connections are general and, unless specified otherwise, can be direct and/or indirect, wired and/or wireless. In this respect, the specification is not intended to be limiting.

[0063] The depicted and/or described steps are merely illustrative and can be omitted, combined, and/or performed in an order other than that depicted and/or described; the numbering of depicted steps is merely for ease of reference and does not imply any particular ordering is necessary or preferred.

[0064] The functions and/or steps described herein can be embodied in computer-usable data and/or computer-executable instructions, executed by one or more computers and/or other devices to perform one or more functions described herein. Generally, such data and/or instructions include routines, programs, objects, components, data structures, or the like that perform particular tasks and/or implement particular data types when executed by one or more processors in a computer and/or other data-processing device. The computer-executable instructions can be stored on a computer-readable medium such as a hard disk, optical disk, removable storage media, solid-state memory, read-only memory (ROM), random-access memory (RAM), and/or the like. As will be appreciated, the functionality of such instructions can be combined and/or distributed as desired. In addition, the functionality can be embodied in whole or in part in firmware and/or hardware equivalents, such as integrated circuits, application-specific integrated circuits (ASICs), field-programmable gate arrays (FPGAs), and/or the like. Particular data structures can be used to more effectively implement one or more aspects of the disclosure, and such data structures are contemplated to be within the scope of computer-executable instructions and/or computer-usable data described herein.

[0065] Although not required, one of ordinary skill in the art will appreciate that various aspects described herein can be embodied as a method, system, apparatus, and/or one or more computer-readable media storing computer-executable instructions. Accordingly, aspects can take the form of an entirely hardware embodiment, an entirely software embodiment, an entirely firmware embodiment, and/or an embodiment combining software, hardware, and/or firmware aspects in any combination.

[0066] As described herein, the various methods and acts can be operative across one or more computing devices and/or networks. The functionality can be distributed in any manner or can be located in a single computing device (e.g., server, client computer, user device, and/or the like).

[0067] Aspects of the disclosure have been described in terms of illustrative embodiments thereof. Numerous other embodiments, modifications, and/or variations within the scope and spirit of the appended claims can occur to persons of ordinary skill in the art from a review of this disclosure. For example, one of ordinary skill in the art can appreciate that the steps depicted and/or described can be performed in other than the recited order and/or that one or more illustrated steps can be optional and/or combined. Any and all features in the following claims can be combined and/or rearranged in any way possible.

[0068] While the present subject matter has been described in detail with respect to various specific example embodiments thereof, each example is provided by way of explanation, not limitation of the disclosure. Those skilled in the art, upon attaining an understanding of the foregoing, can readily produce alterations to, variations of, and/or equivalents to such embodiments. Accordingly, the subject disclosure does not preclude inclusion of such modifications, variations, and/or additions to the present subject matter as would be readily apparent to one of ordinary skill in the art. For instance, features illustrated and/or described as part of one embodiment can be used with another embodiment to yield a further embodiment. Thus, it is intended that the present disclosure cover such alterations, variations, and/or equivalents.

WHAT IS CLAIMED IS:

1. A computer-implemented method comprising:

receiving, by one or more computing devices and from one or more sensors, data describing one or more three-dimensional motions comprising a three-dimensional-human-gesture input;

generating, by the one or more computing devices and based at least in part on the data describing the one or more three-dimensional motions, two-dimensional data at least partially describing at least one motion of the one or more three-dimensional motions; and

identifying, by the one or more computing devices and based at least in part on the two-dimensional data, the three-dimensional-human-gesture input, wherein identifying the three-dimensional-human-gesture input comprises:

identifying, based at least in part on the two-dimensional data and one or more two-dimensional-movement-recognition models, a two-dimensional movement; and

identifying, based at least in part on the two-dimensional movement, the three-dimensional-human-gesture input.

2. The computer-implemented method of claim 1, wherein generating the two-dimensional data comprises projecting a representation of at least a portion of the data describing the one or more three-dimensional motions onto a two-dimensional plane defined by each dimension of the two-dimensional data.

3. The computer-implemented method of claim 2, wherein:

the one or more three-dimensional motions comprise one or more actions by a user; and

the method comprises:

generating, by the one or more computing devices, data describing one or more graphical interfaces comprising one or more elements depicting the representation of the at least a portion of the data describing the one or more three-dimensional motions; and

communicating, by the one or more computing devices and to a display device, the data describing the one or more graphical interfaces for viewing by the user.

4. The computer-implemented method of claim 1, wherein:

the one or more computing devices store data describing a plurality of different predefined, distinct three-dimensional-human-gesture inputs;

the data describing the plurality of different predefined, distinct three-dimensional-human-gesture inputs comprises, for each particular three-dimensional-human-gesture input of the plurality of different predefined, distinct three-dimensional-human-gesture inputs, two-dimensional data describing one or more three-dimensional motions associated with the particular three-dimensional-human-gesture input; and

identifying the three-dimensional-human-gesture input comprises identifying the three-dimensional-human-gesture input from amongst the plurality of different predefined, distinct three-dimensional-human-gesture inputs based at least in part on a correspondence between:

at least a portion of the two-dimensional data at least partially describing the at least one motion of the one or more three-dimensional motions, and

at least a portion of the data describing the plurality of different predefined, distinct three-dimensional-human-gesture inputs.

5. The computer-implemented method of claim 4, wherein:

the one or more three-dimensional motions are associated with an object;

the method comprises identifying, by the one or more computing devices, the object from amongst a plurality of different predefined, distinct objects associated with the plurality of different predefined, distinct three-dimensional-human-gesture inputs; and

identifying the three-dimensional-human-gesture input comprises identifying the at least a portion of the data describing the plurality of different predefined, distinct three-dimensional-human-gesture inputs based at least in part on the object.

6. The computer-implemented method of claim 1, comprising, responsive to identifying the three-dimensional-human-gesture input:

identifying, by the one or more computing devices, one or more functions associated with the three-dimensional-human-gesture input; and

invoking, by the one or more computing devices, the one or more functions.

7. The computer-implemented method of claim 1, wherein the one or more sensors comprise one or more inertial measurement unit (IMU) sensors.

8. The computer-implemented method of claim 1, wherein the one or more sensors comprise one or more camera sensors.

9. The computer-implemented method of claim 1, wherein the one or more sensors comprise at least one of:

one or more ultrasound sensors, or

one or more radar sensors.

10. The computer-implemented method of claim 1, wherein:

the one or more three-dimensional motions include an object;

the one or more three-dimensional motions comprise one or more actions by a user; and

the object comprises a body part of the user.

11. The computer-implemented method of claim 1, wherein:

the one or more three-dimensional motions include an object;

the one or more three-dimensional motions comprise one or more actions by a user; and

the one or more actions comprise at least one of:

the user manipulating the object,

the user moving the object,

the user repositioning the object, or

the user tilting the object.

12. The computer-implemented method of claim 1, wherein the one or more three-dimensional motions comprise one or more actions by a user wearing an article comprising at least one of the one or more sensors.

13. The computer-implemented method of claim 1, wherein the one or more three-dimensional motions include an object comprising at least one of the one or more sensors.

14. The computer-implemented method of claim 1, wherein identifying the three-dimensional-human-gesture input comprises one or more of:

utilizing a stroke-recognition algorithm to analyze at least a portion of the two-dimensional data;

utilizing a character-recognition algorithm to analyze at least a portion of the two-dimensional data; or

utilizing a handwriting-recognition algorithm to analyze at least a portion of the two-dimensional data.

15. The computer-implemented method of claim 1, wherein:

the one or more computing devices comprise a first computing device and a second computing device;

the first computing device and the second computing device are physically distinct from one another;

one or more networks interface the first computing device with the second computing device;

receiving the data describing the one or more three-dimensional motions comprises receiving, by the first computing device, the data describing the one or more three-dimensional motions;

the method comprises communicating, by the first computing device, the data describing the one or more three-dimensional motions to the second computing device via the one or more networks; and

generating the two-dimensional data comprises generating, by the second computing device, the two-dimensional data.

16. The computer-implemented method of claim 1, wherein:

the one or more computing devices comprise a first computing device and a second computing device;

the first computing device and the second computing device are physically distinct from one another;

one or more networks interface the first computing device with the second computing device;

generating the two-dimensional data comprises generating, by the first computing device, the two-dimensional data;

the method comprises communicating, by the first computing device, the two-dimensional data to the second computing device via the one or more networks; and

identifying the three-dimensional-human-gesture input comprises identifying, by the second computing device, the three-dimensional-human-gesture input.

17. The computer-implemented method of claim 1, wherein:

the one or more computing devices comprise a first computing device and a second computing device;

the first computing device and the second computing device are physically distinct from one another;

the first computing device is a different type of computing device from the second computing device;

identifying the three-dimensional-human-gesture input comprises:

identifying, by the first computing device, the three-dimensional-human-gesture input, and

identifying, by the second computing device, the three-dimensional-human-gesture input; and

the method comprises:

responsive to the first computing device identifying the three-dimensional-human-gesture input:

identifying, by the first computing device, one or more functions associated with the first computing device that are associated with the three-dimensional-human-gesture input, and

invoking, by the first computing device, the one or more functions associated with the first computing device; and

responsive to the second computing device identifying the three-dimensional-human-gesture input:

identifying, by the second computing device, one or more functions associated with the second computing device that are associated with the three-dimensional-human-gesture input, and invoking, by the second computing device, the one or more functions associated with the second computing device, the one or more functions associated with the first computing device being different from the one or more functions associated with the second computing device.

18. The computer-implemented method of claim 1, wherein:

the one or more computing devices comprise a first computing device and a second computing device;

the first computing device and the second computing device are physically distinct from one another;

the first computing device is a different type of computing device from the second computing device;

the one or more three-dimensional motions comprise an additional three-dimensional-human-gesture input;

identifying the three-dimensional-human-gesture input comprises identifying, by the first computing device, the three-dimensional-human-gesture input; and

the method comprises:

identifying, by the second computing device and based at least in part on the two-dimensional data, the additional three-dimensional-human-gesture input;

responsive to the first computing device identifying the three-dimensional-human-gesture input:

identifying, by the first computing device, one or more functions associated with the first computing device that are associated with the three-dimensional-human-gesture input, and

invoking, by the first computing device, the one or more functions associated with the first computing device; and

responsive to the second computing device identifying the additional three-dimensional-human-gesture input:

identifying, by the second computing device, one or more functions associated with the second computing device that are associated with the additional three-dimensional-human-gesture input, and

invoking, by the second computing device, the one or more functions associated with the second computing device, the one or more functions associated with the first computing device being different from the one or more functions associated with the second computing device.

19. A system comprising:

one or more processors; and

a memory storing instructions that when executed by the one or more processors cause the system to perform operations comprising:

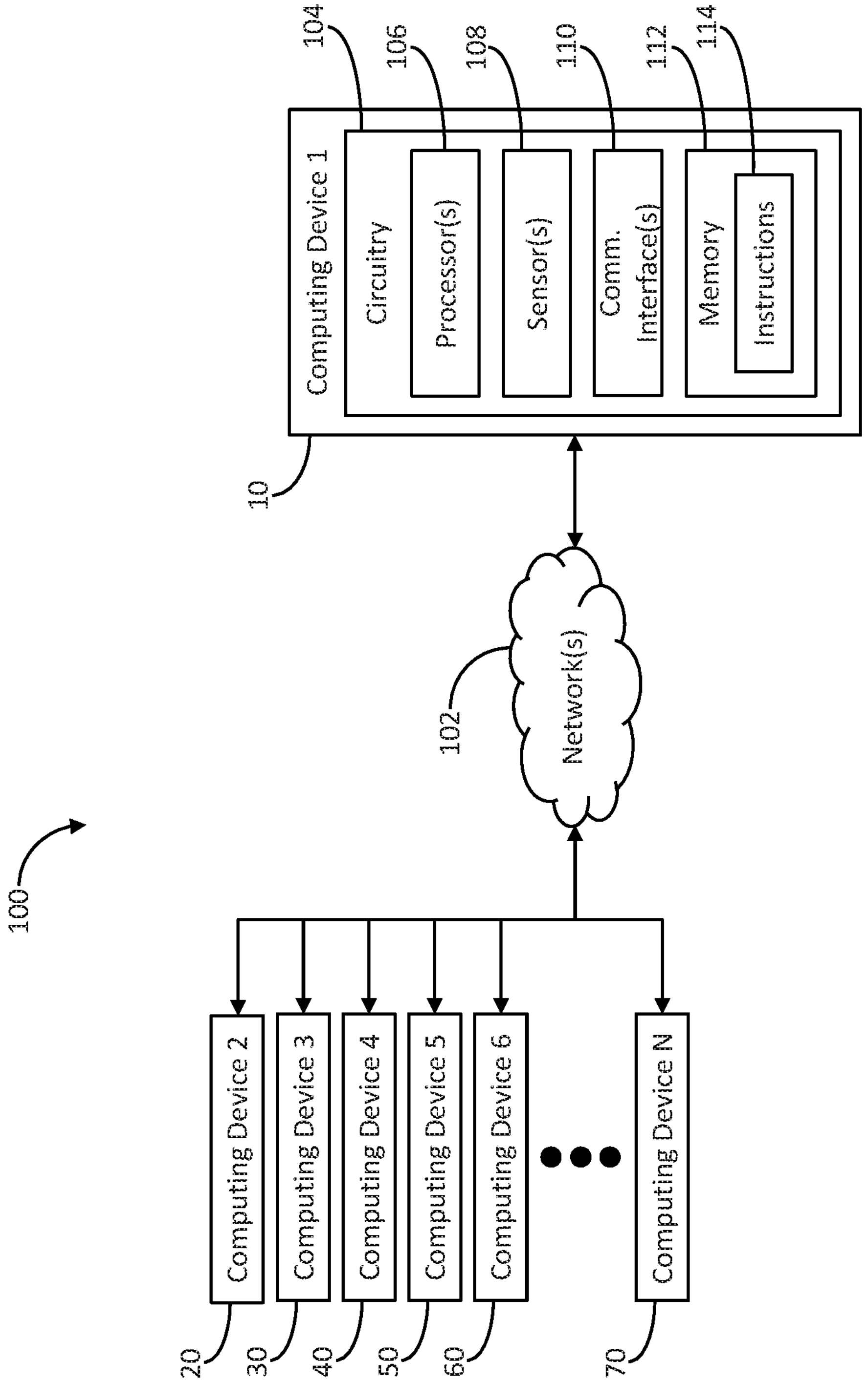
generating, based at least in part on data describing one or more three-dimensional motions, two-dimensional data at least partially describing at least one motion of the one or more three-dimensional motions; and

identifying, based at least in part on the two-dimensional data, a three-dimensional-human-gesture input within the one or more three-dimensional motions.

20. One or more non-transitory computer-readable media comprising instructions that when executed by one or more computing devices cause the one or more computing devices to perform operations comprising:

projecting, onto a two-dimensional plane, a representation of at least a portion of data describing one or more three-dimensional motions comprising a three-dimensional-human-gesture input; and

identifying, based at least in part on the representation, the three-dimensional-human-gesture input.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Computing Device 1
Circuitry
Processor(s)
Sensor(s)
Comm. Interface(s)
Memory
Instructions
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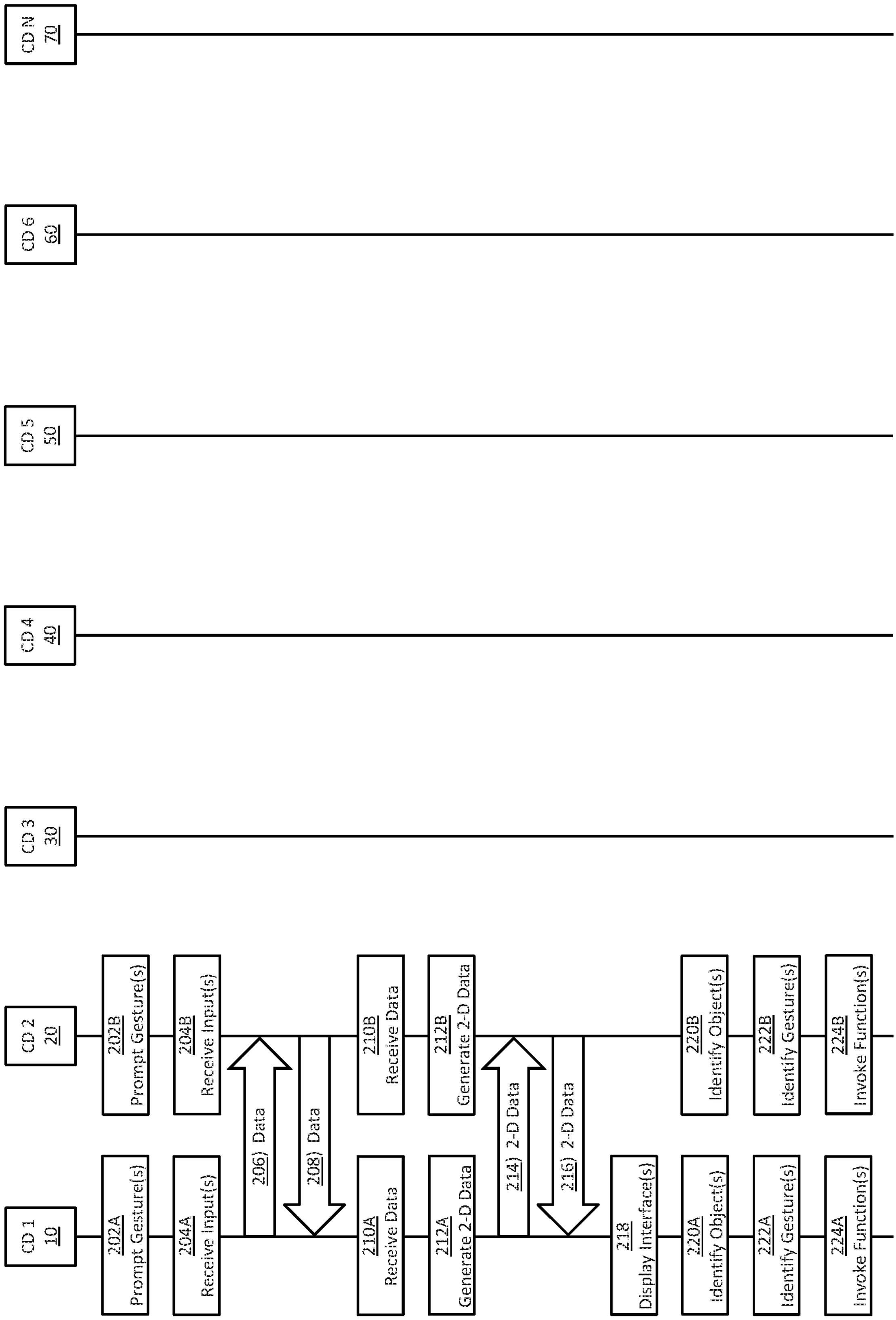
106
108
110
112
114
10
Network(s)
102
Computing Device 2
Computing Device 3
Computing Device 4
Computing Device 5
Computing Device 6
Computing Device N
20
30
40
50
60
70

FIG. 1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CD 6
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CD 5
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CD 4
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CD 3
30
CD 2
20
CD 1
10
202B
Prompt Gesture(s)
204B
Receive Input(s)
210B
Receive Data
212B
Generate 2-D Data
220B
Identify Object(s)
222B
Identify Gesture(s)
224B
Invoke Function(s)
206) Data
208) Data
214) 2-D Data
216) 2-D Data
202A
Prompt Gesture(s)
204A
Receive Input(s)
210A
Receive Data
212A
Generate 2-D Data
218
Display Interface(s)
220A
Identify Object(s)
222A
Identify Gesture(s)
224A
Invoke Function(s)

FIG. 2A

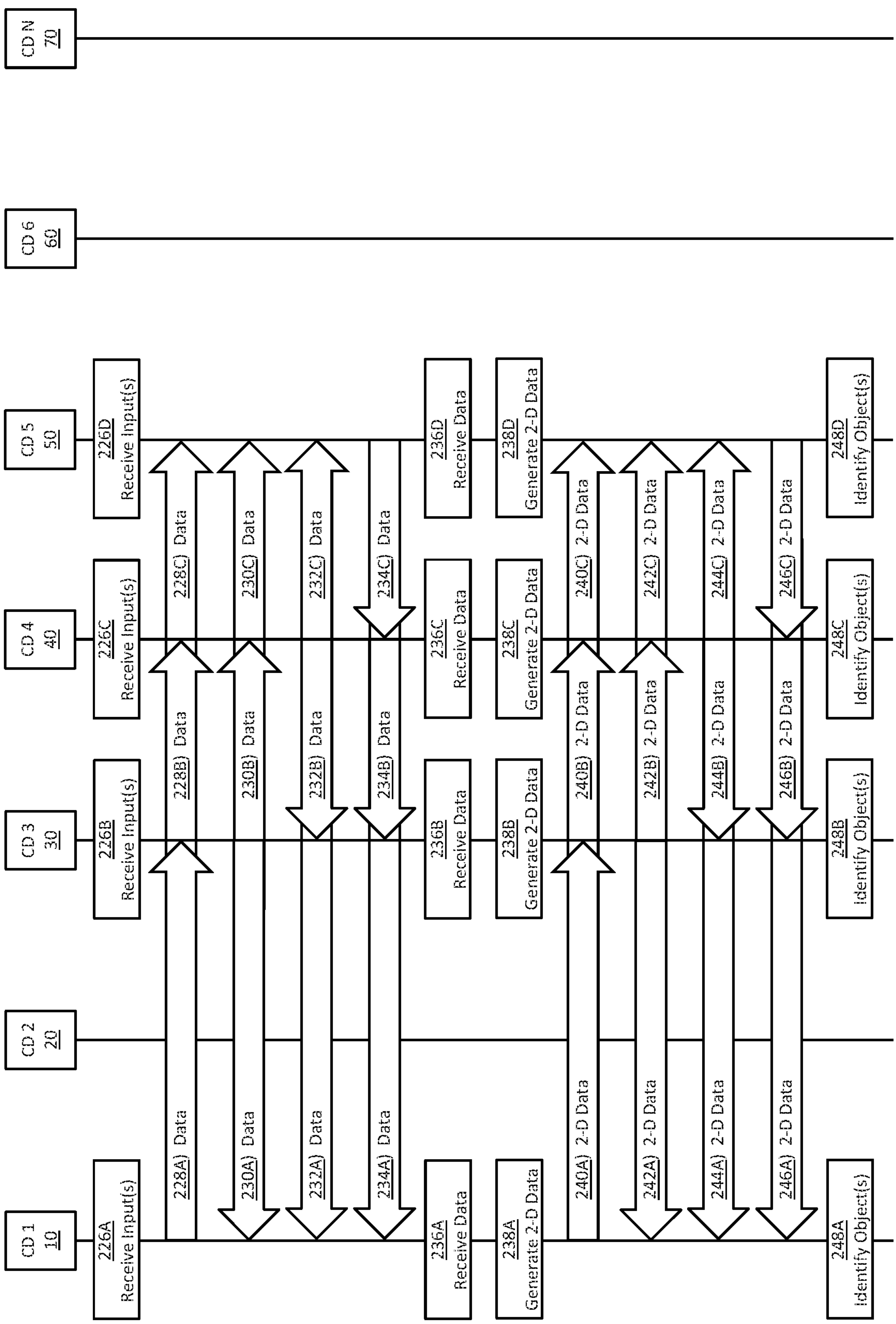
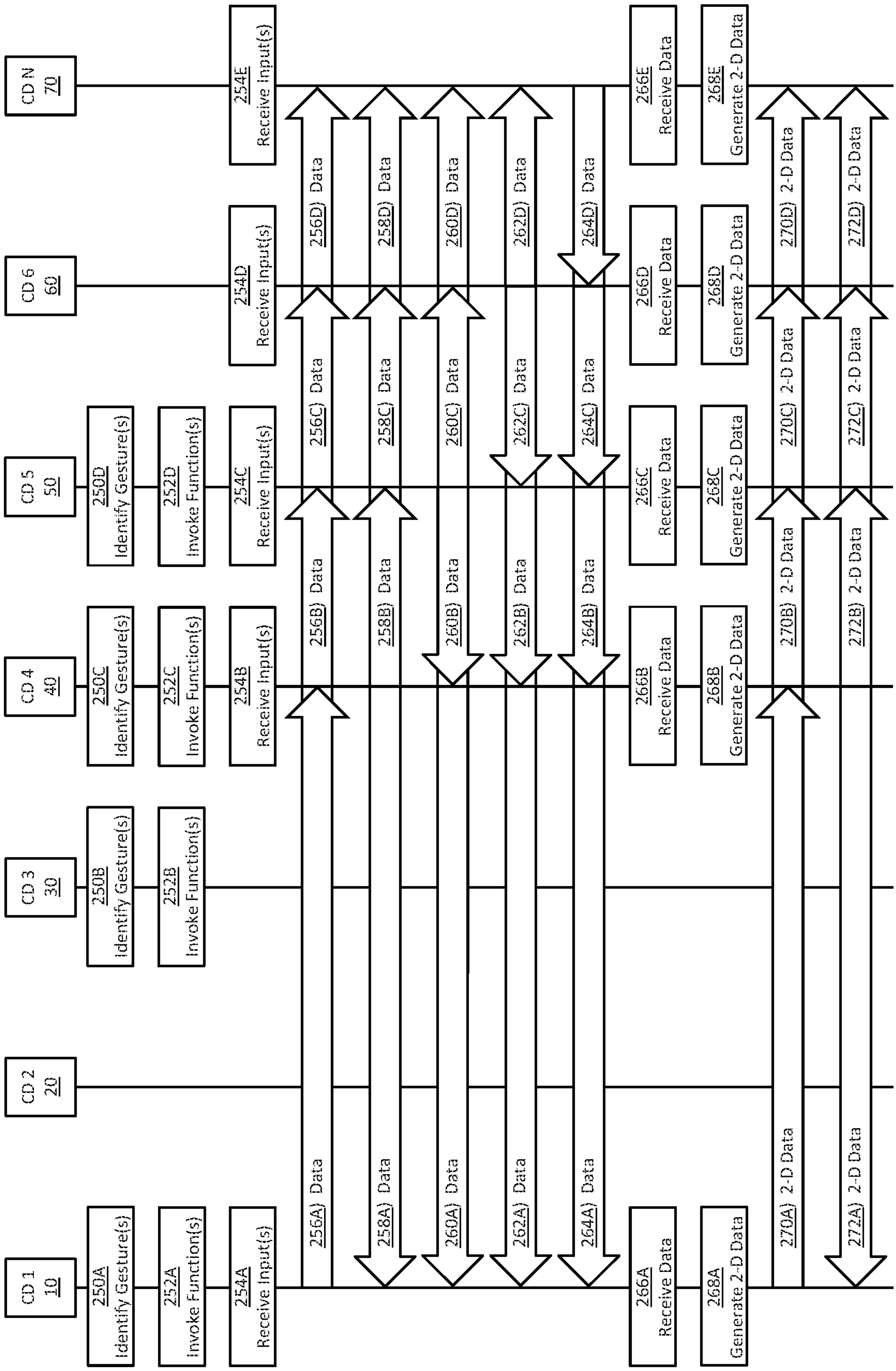

CD 1 10
CD 2 20
CD 3 30
CD 4 40
CD 5 50
CD 6 60
CD N 70
226A Receive Input(s)
226B Receive Input(s)
226C Receive Input(s)
226D Receive Input(s)
228A) Data
228B) Data
228C) Data
230A) Data
230B) Data
230C) Data
232A) Data
232B) Data
232C) Data
234A) Data
234B) Data
234C) Data
236A Receive Data
236B Receive Data
236C Receive Data
236D Receive Data
238A Generate 2-D Data
238B Generate 2-D Data
238C Generate 2-D Data
238D Generate 2-D Data
240A) 2-D Data
240B) 2-D Data
240C) 2-D Data
242A) 2-D Data
242B) 2-D Data
242C) 2-D Data
244A) 2-D Data
244B) 2-D Data
244C) 2-D Data
246A) 2-D Data
246B) 2-D Data
246C) 2-D Data
248A Identify Object(s)
248B Identify Object(s)
248C Identify Object(s)
248D Identify Object(s)

FIG. 2B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CD 2 20
CD 3 30
CD 4 40
CD 5 50
CD 6 60
CD N 70
250A Identify Gesture(s)
250B Identify Gesture(s)
250C Identify Gesture(s)
250D Identify Gesture(s)
252A Invoke Function(s)
252B Invoke Function(s)
252C Invoke Function(s)
252D Invoke Function(s)
254A Receive Input(s)
254B Receive Input(s)
254C Receive Input(s)
254D Receive Input(s)
254E Receive Input(s)
256A) Data
256B) Data
256C) Data
256D) Data
258A) Data
258B) Data
258C) Data
258D) Data
260A) Data
260B) Data
260C) Data
260D) Data
262A) Data
262B) Data
262C) Data
262D) Data
264A) Data
264B) Data
264C) Data
264D) Data
266A Receive Data
266B Receive Data
266C Receive Data
266D Receive Data
266E Receive Data
268A Generate 2-D Data
268B Generate 2-D Data
268C Generate 2-D Data
268D Generate 2-D Data
268E Generate 2-D Data
270A) 2-D Data
270B) 2-D Data
270C) 2-D Data
270D) 2-D Data
272A) 2-D Data
272B) 2-D Data
272C) 2-D Data
272D) 2-D Data

FIG. 2C

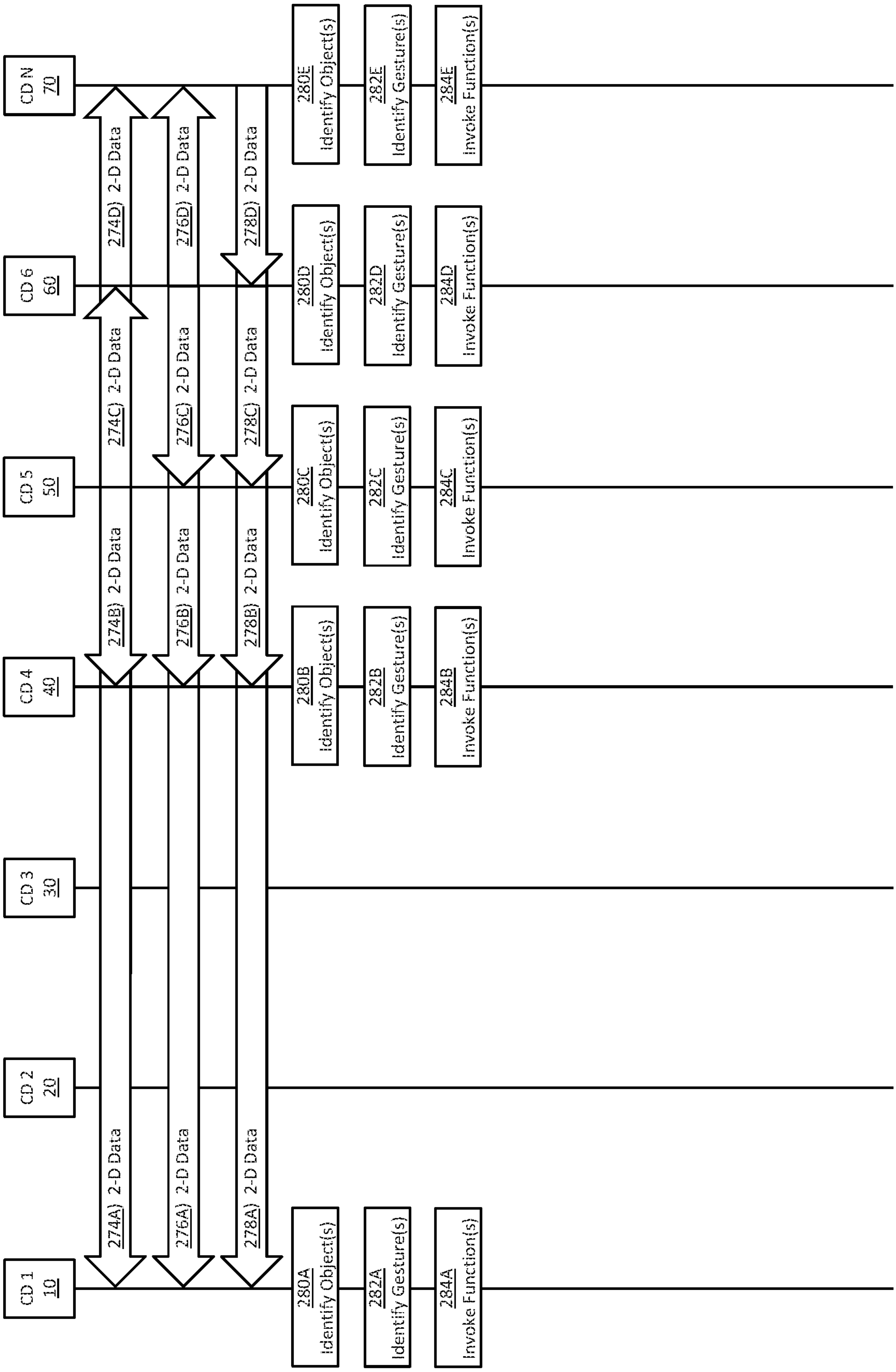

CD 1 10
CD 2 20
CD 3 30
CD 4 40
CD 5 50
CD 6 60
CD N 70
274A) 2-D Data
276A) 2-D Data
278A) 2-D Data
274B) 2-D Data
276B) 2-D Data
278B) 2-D Data
274C) 2-D Data
276C) 2-D Data
278C) 2-D Data
274D) 2-D Data
276D) 2-D Data
278D) 2-D Data
280A Identify Object(s)
282A Identify Gesture(s)
284A Invoke Function(s)
280B Identify Object(s)
282B Identify Gesture(s)
284B Invoke Function(s)
280C Identify Object(s)
282C Identify Gesture(s)
284C Invoke Function(s)
280D Identify Object(s)
282D Identify Gesture(s)
284D Invoke Function(s)
280E Identify Object(s)
282E Identify Gesture(s)
284E Invoke Function(s)

FIG. 2D

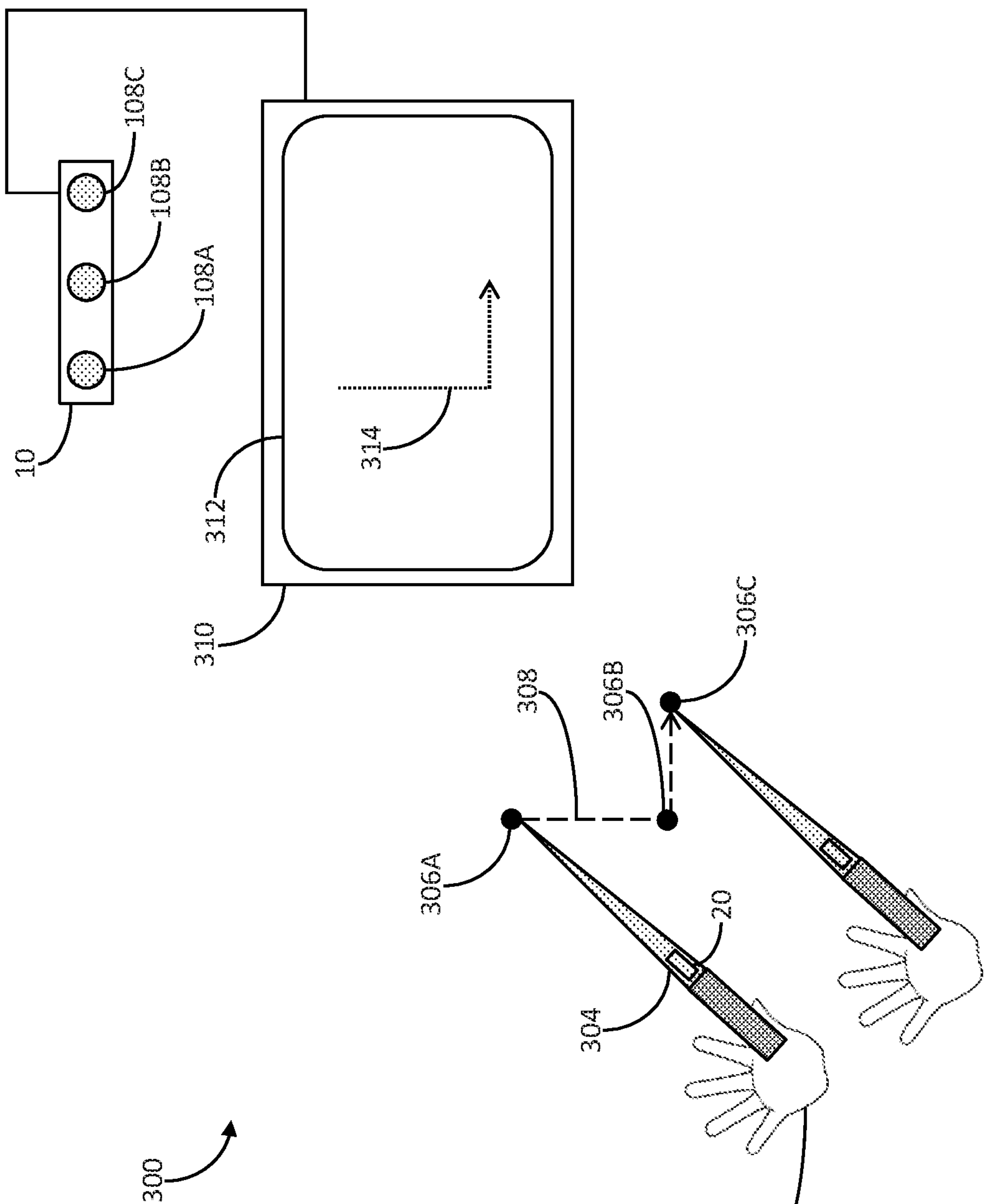


FIG. 3

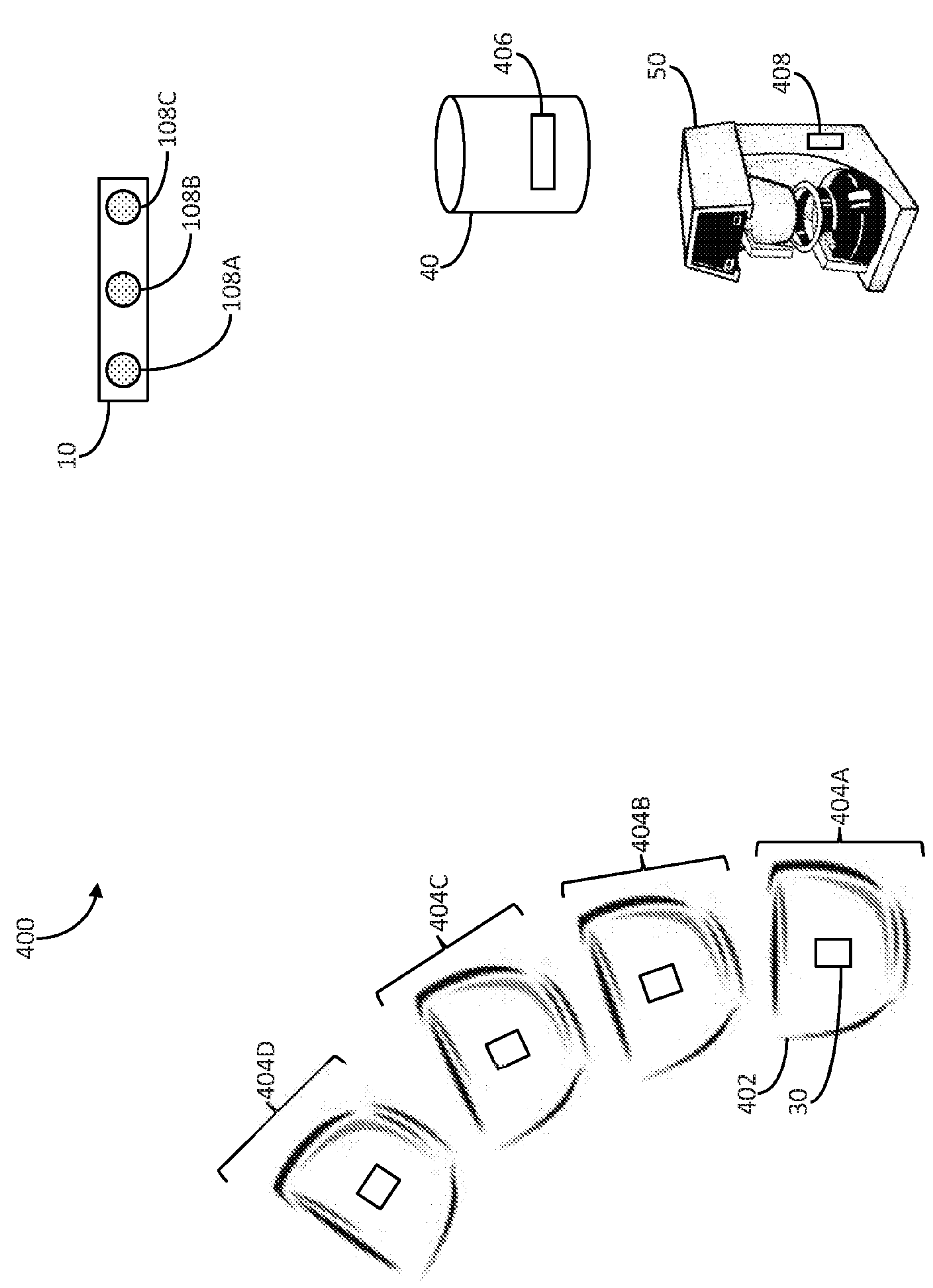
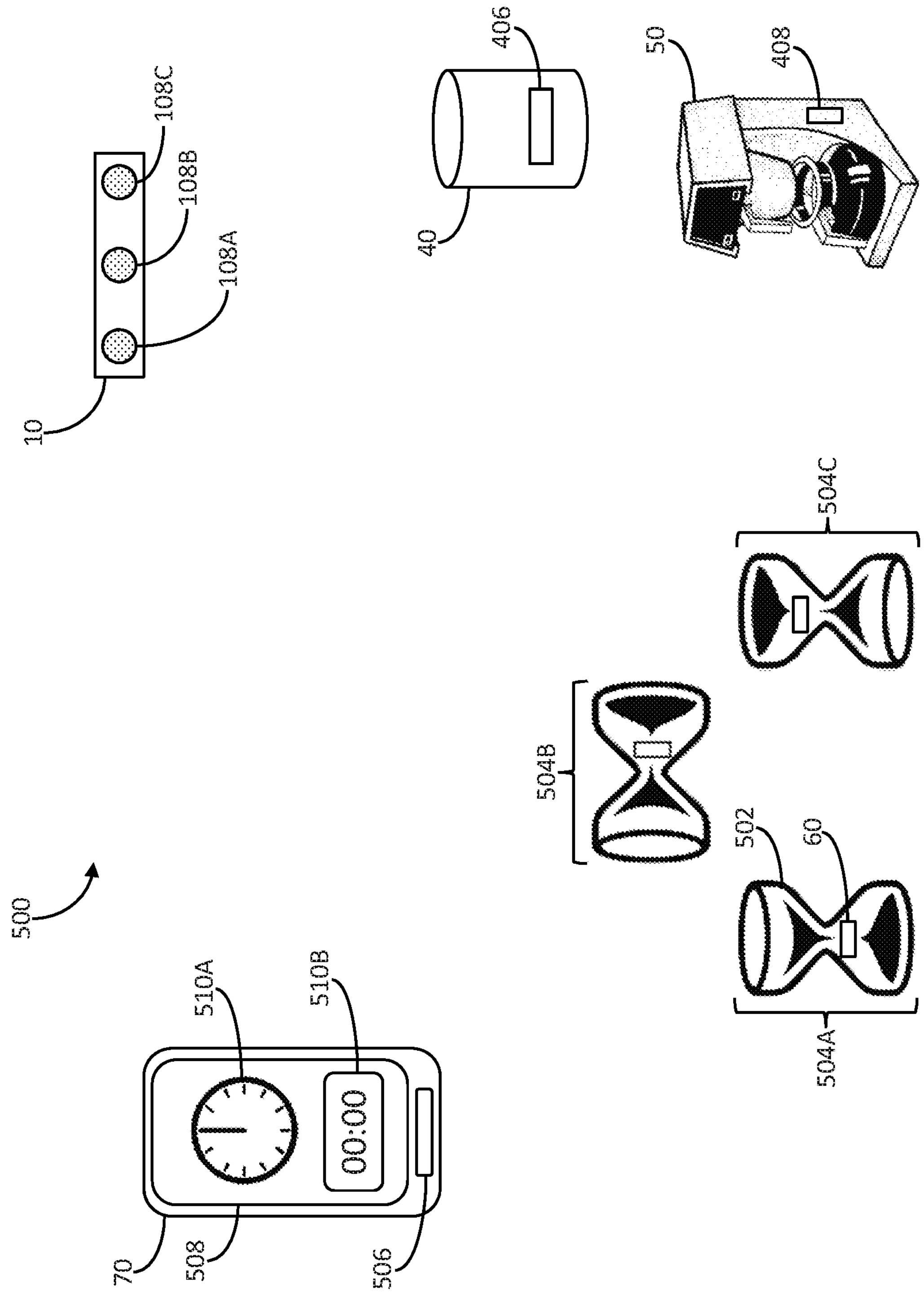


FIG. 4



500
10
108A
108B
108C
40
406
50
408
504A
504B
504C
502
60
70
508
506
510A
510B
00:00

FIG. 5

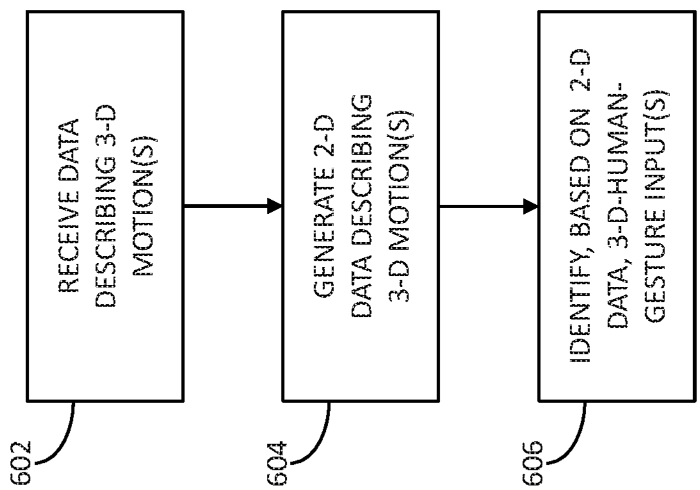

RECEIVE DATA DESCRIBING 3-D MOTION(S)
GENERATE 2-D DATA DESCRIBING 3-D MOTION(S)
IDENTIFY, BASED ON 2-D DATA, 3-D-HUMAN-GESTURE INPUT(S)
602
604
606

FIG. 6

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2019/034319

A. CLASSIFICATION OF SUBJECT MATTER
INV. G06F3/0346 G06F3/01 G06F3/023
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
G06F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

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

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y	US 2015/261301 A1 (HAGIWARA MASATO [JP] ET AL) 17 September 2015 (2015-09-17) paragraphs [0038] - [0061]; figures 1-11 paragraphs [0070] - [0074]; figure 18 -----	1-14,19, 20 15-18
Y A	WO 2015/105919 A2 (NOD INC [US]) 16 July 2015 (2015-07-16) page 3 - page 17, paragraph 3; figures 1-13 -----	15-18 7
A	US 2014/282275 A1 (EVERITT ANDREW J [GB] ET AL) 18 September 2014 (2014-09-18) paragraph [0107] -----	9

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
2 August 2019	12/08/2019

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Legrand, J

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/US2019/034319

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
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		JP WO2014054717 A1	25-08-2016
		US 2015261301 A1	17-09-2015
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		EP 2972671 A1	20-01-2016
		JP 2016515268 A	26-05-2016
		KR 20150127674 A	17-11-2015
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