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(54) **INTERACTING WITH DEVICES BASED ON PHYSICAL DEVICE-TO-DEVICE CONTACT**

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(57) **ABSTRACT**

A device may receive a signal from a sensor coupled to a first device, determine whether the first device is tapped against a second device based on the signal, send a message to the second device when the first device is tapped against the second device, determine if the taps are valid user input based on a response from the second device, and perform an application specific action when the taps are valid user input.



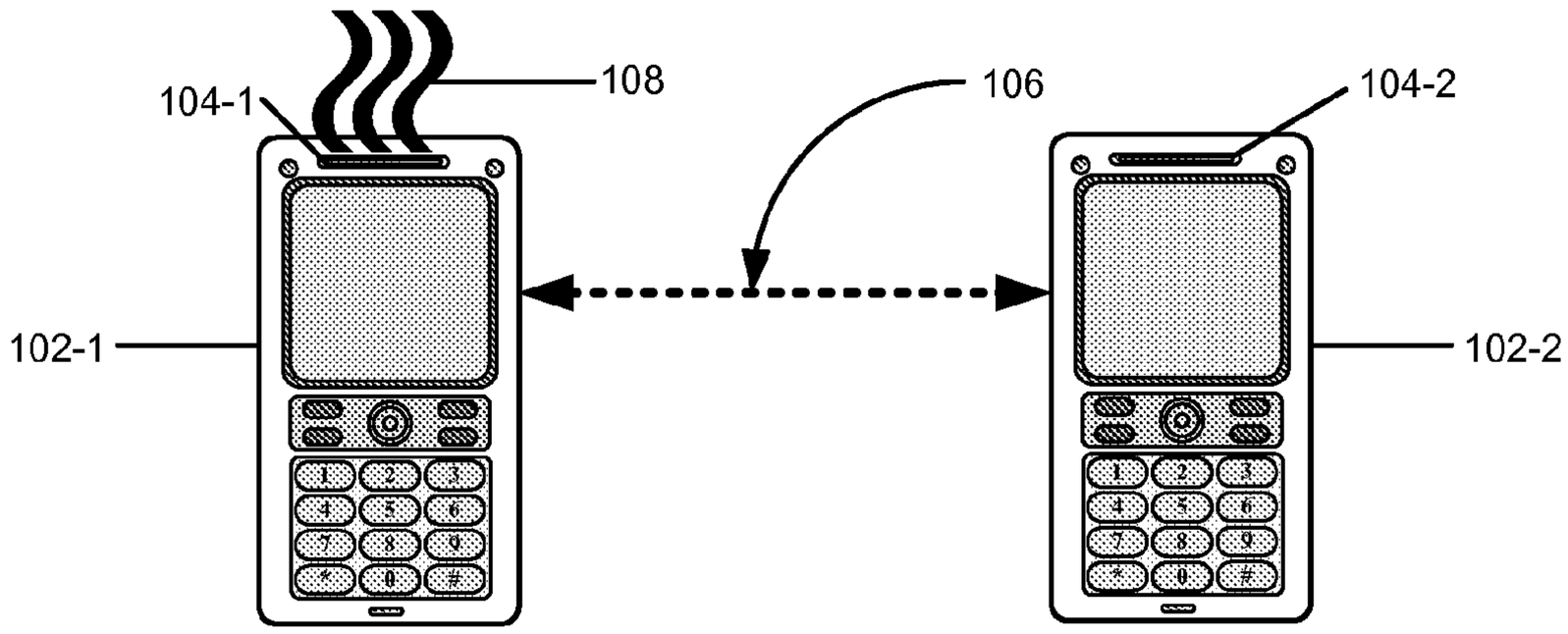

Fig. 1A



Fig. 1B

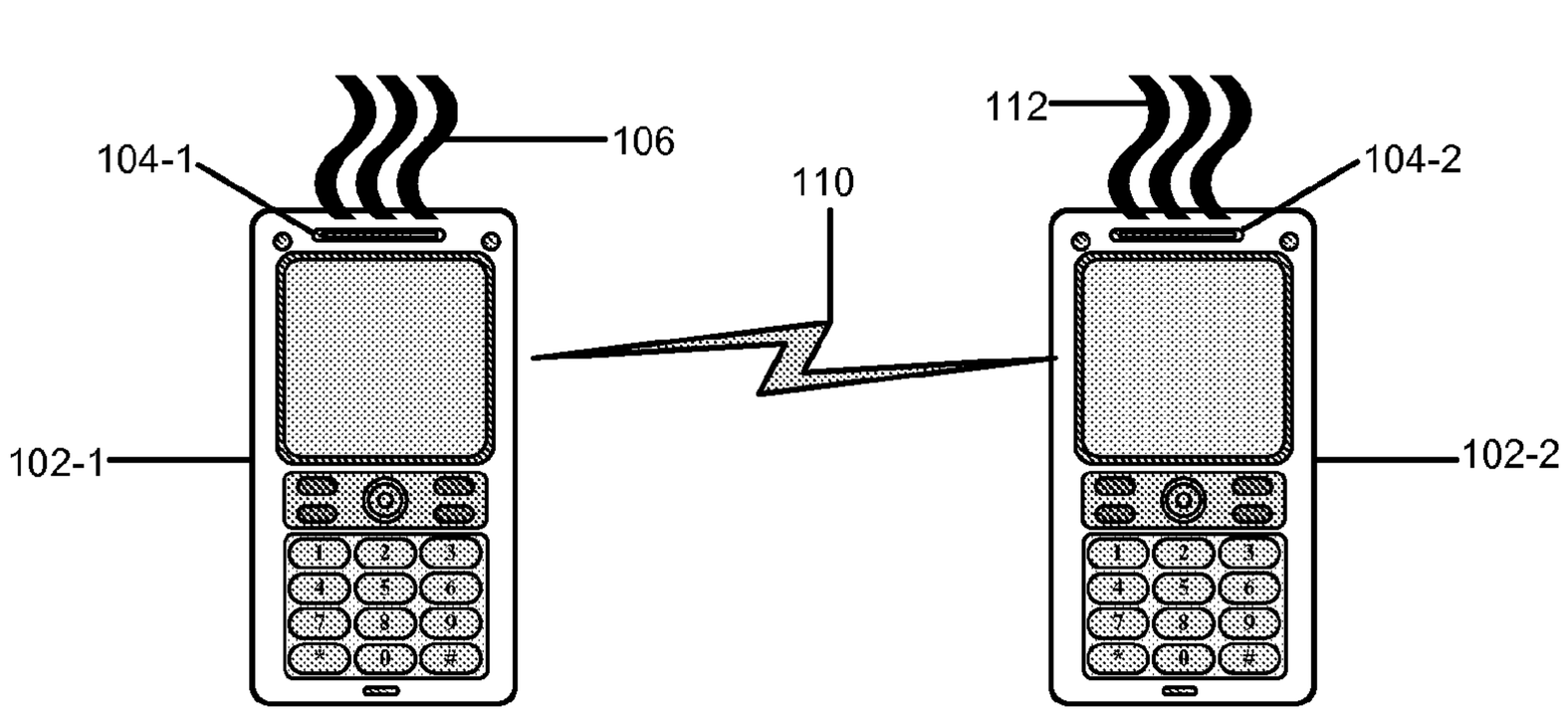

Fig. 1C

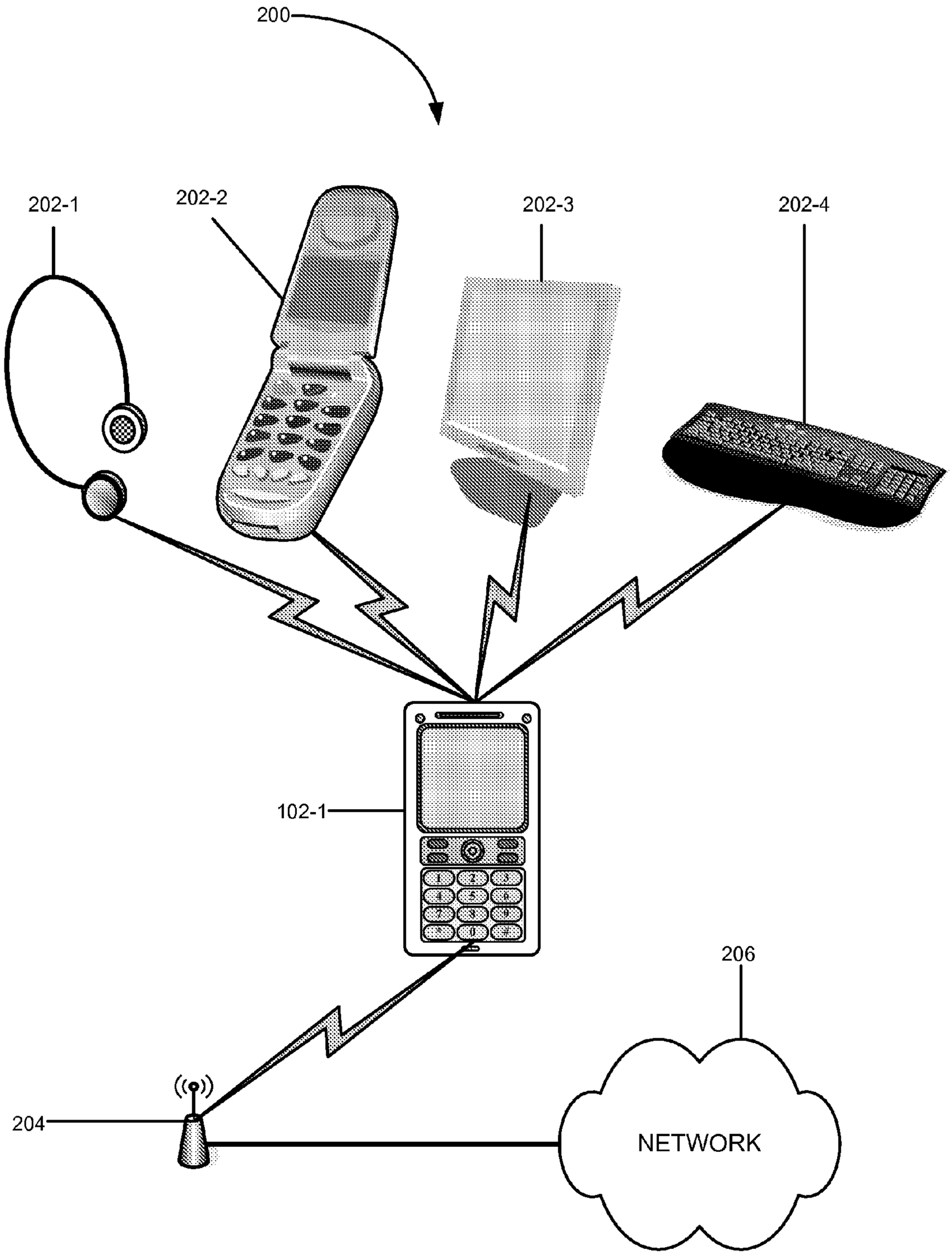

Fig. 2

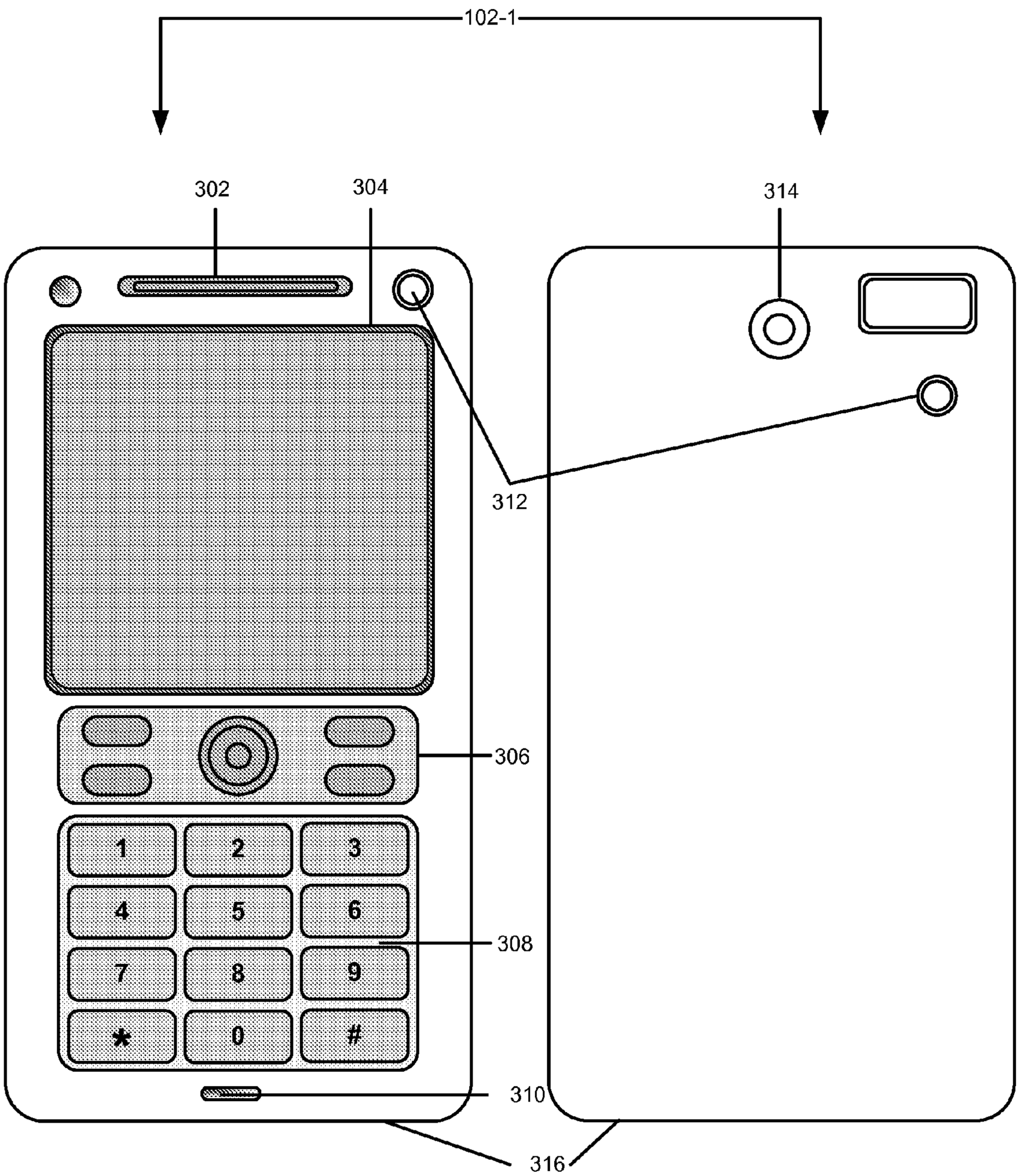

Fig. 3A

Fig. 3B

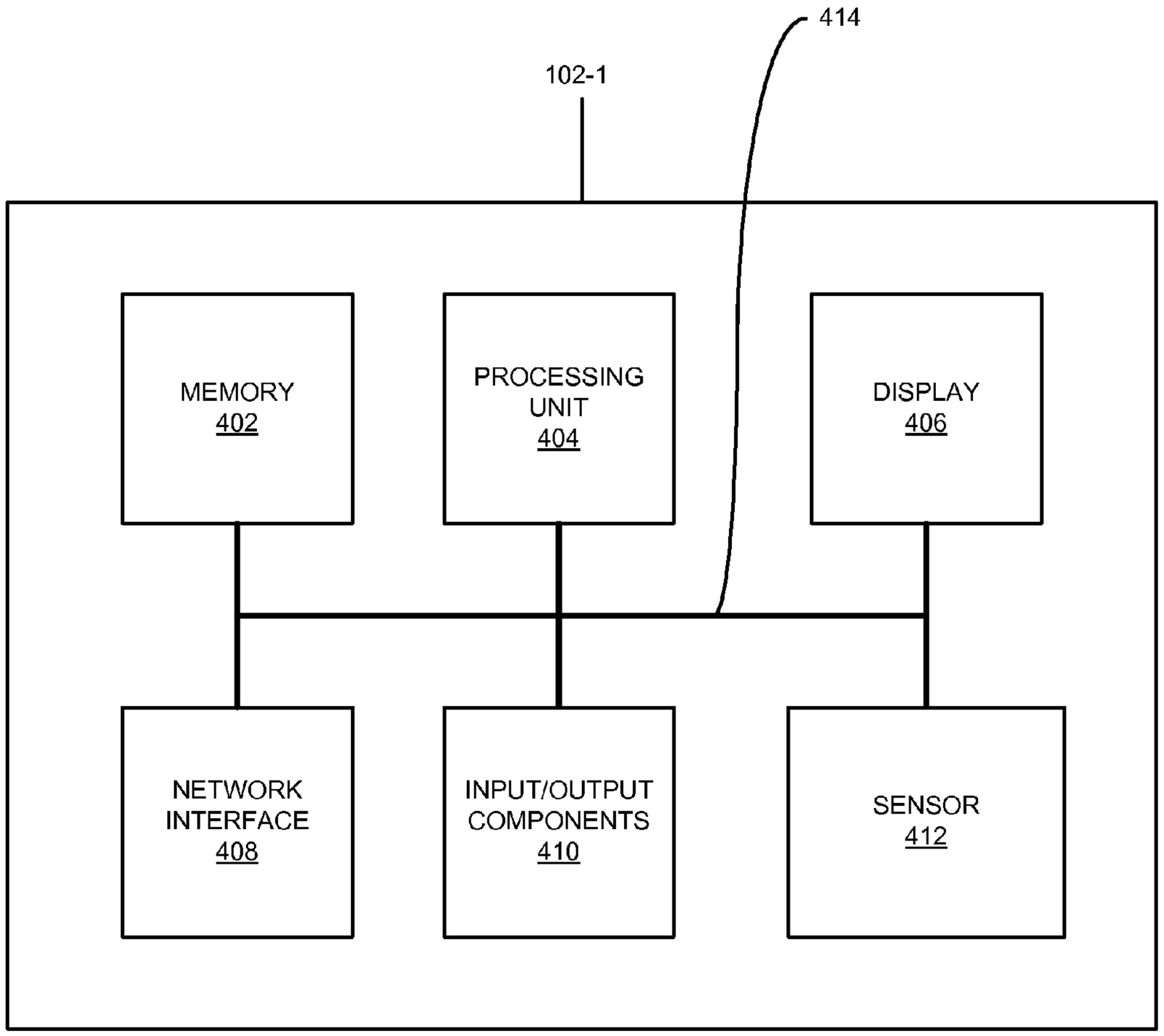
414
102-1
MEMORY
402
PROCESSING
UNIT
404
DISPLAY
406
NETWORK
INTERFACE
408
INPUT/OUTPUT
COMPONENTS
410
SENSOR
412

Fig. 4

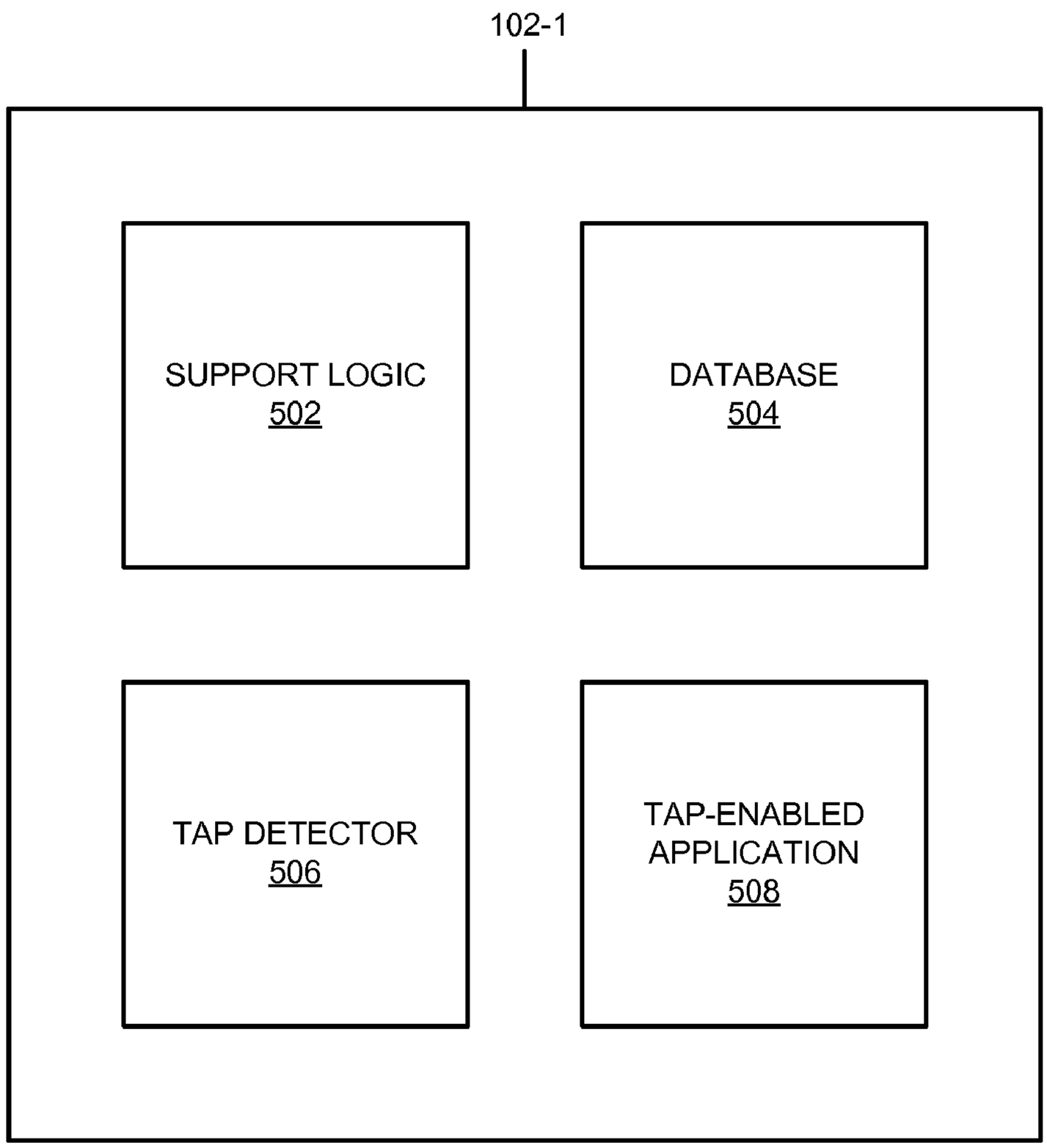
102-1
SUPPORT LOGIC
502
DATABASE
504
TAP DETECTOR
506
TAP-ENABLED
APPLICATION
508

Fig. 5

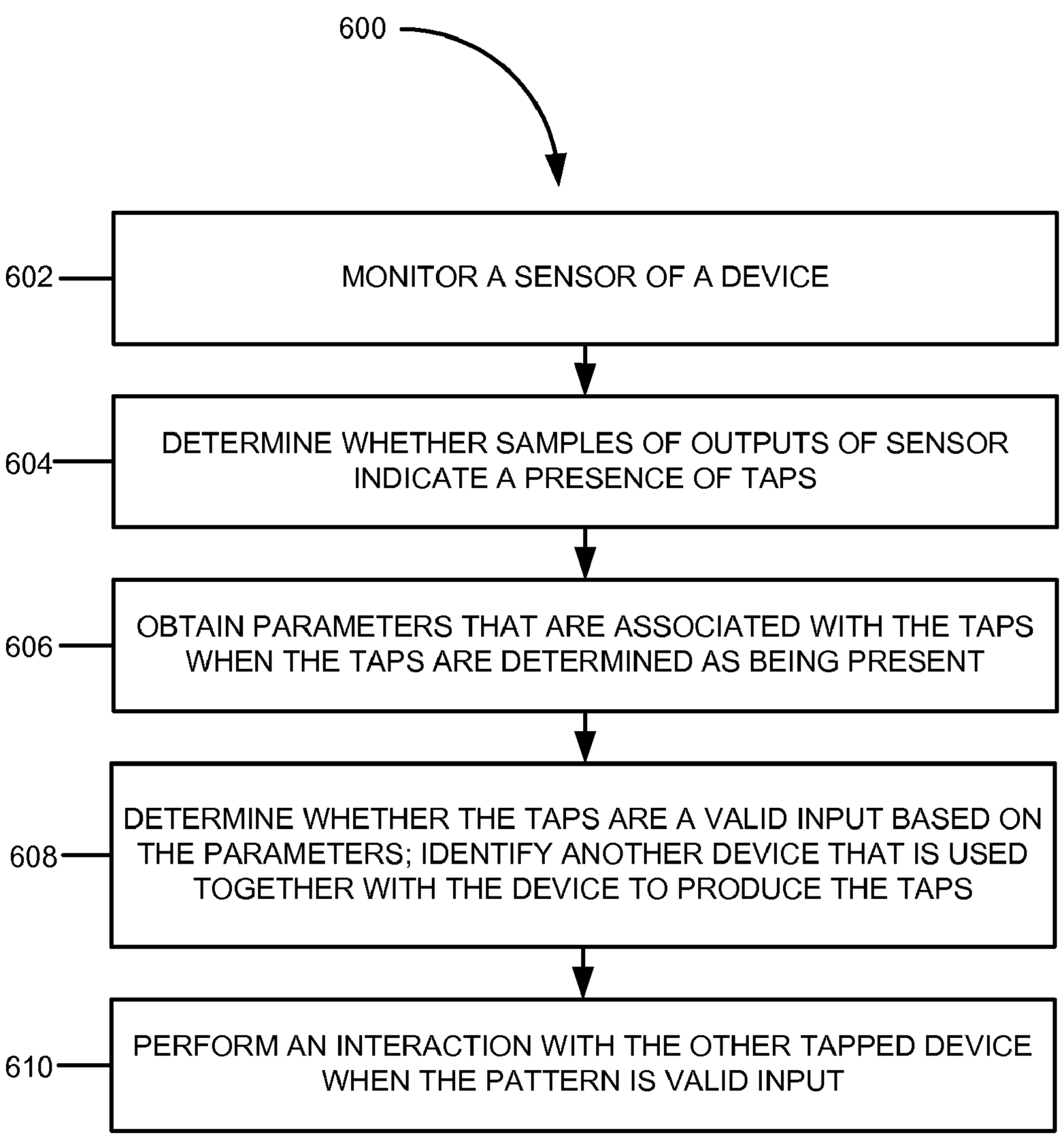
600
602
MONITOR A SENSOR OF A DEVICE
604
DETERMINE WHETHER SAMPLES OF OUTPUTS OF SENSOR INDICATE A PRESENCE OF TAPS
606
OBTAIN PARAMETERS THAT ARE ASSOCIATED WITH THE TAPS WHEN THE TAPS ARE DETERMINED AS BEING PRESENT
608
DETERMINE WHETHER THE TAPS ARE A VALID INPUT BASED ON THE PARAMETERS; IDENTIFY ANOTHER DEVICE THAT IS USED TOGETHER WITH THE DEVICE TO PRODUCE THE TAPS
610
PERFORM AN INTERACTION WITH THE OTHER TAPPED DEVICE WHEN THE PATTERN IS VALID INPUT

Fig. 6

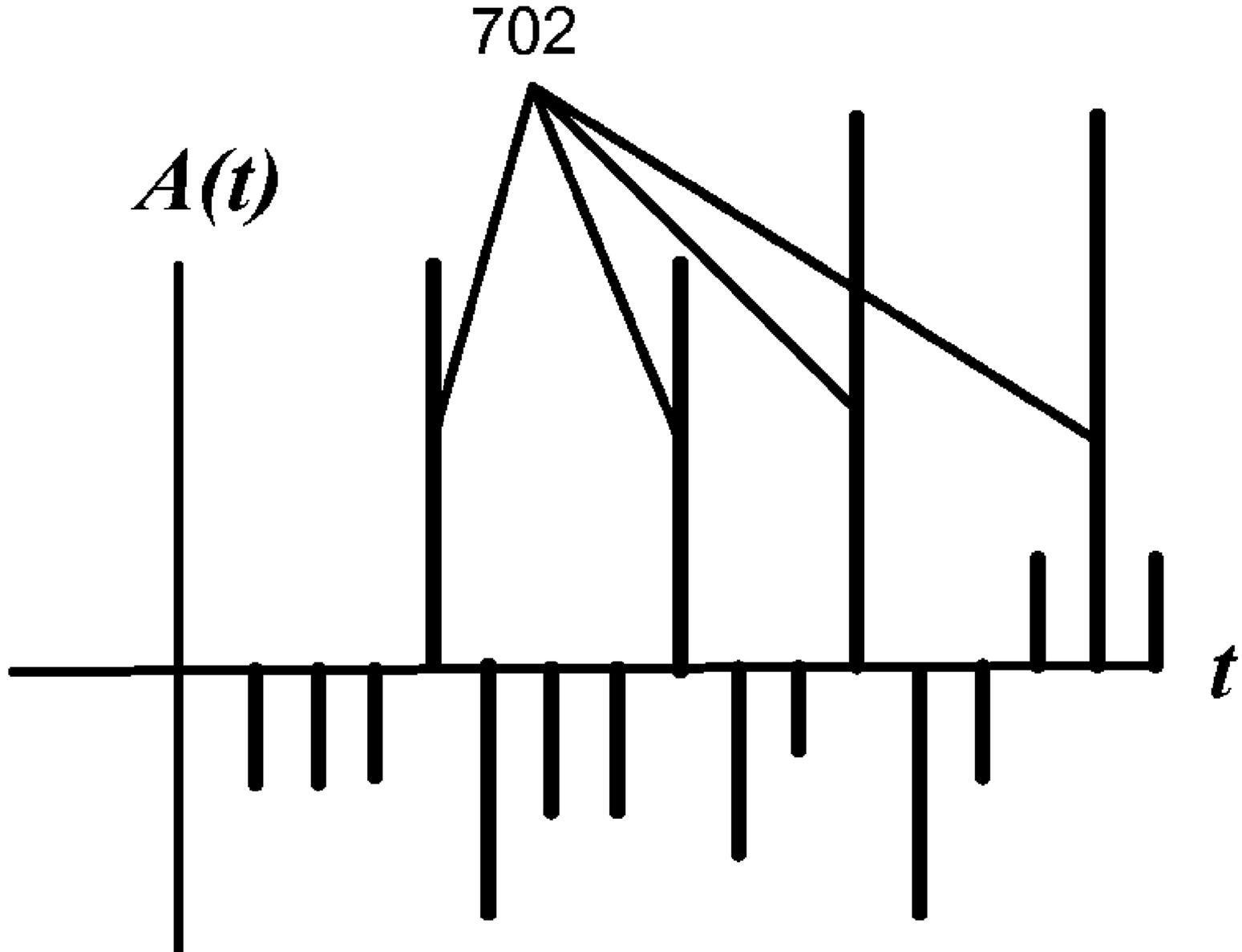

Fig. 7

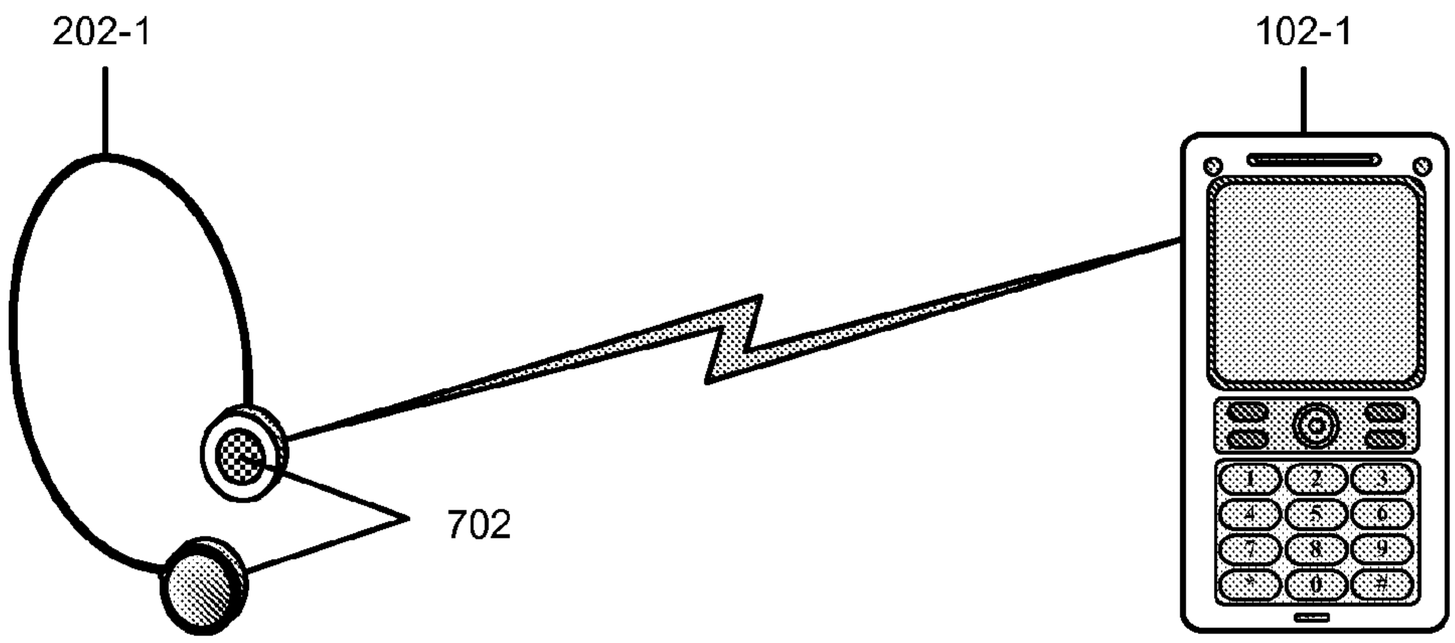

Fig. 8A

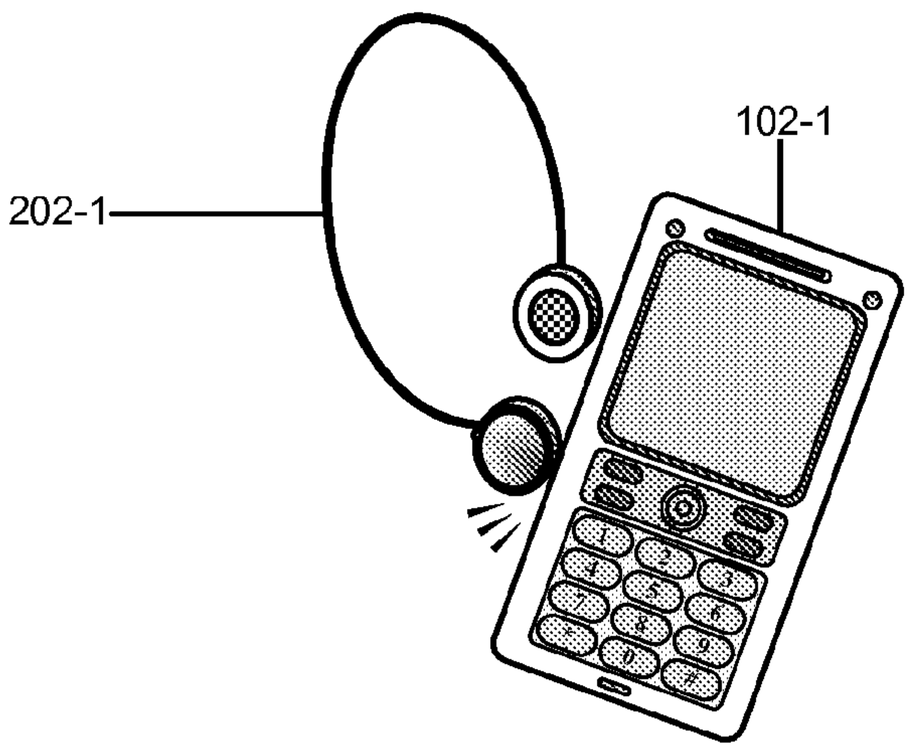

Fig. 8B

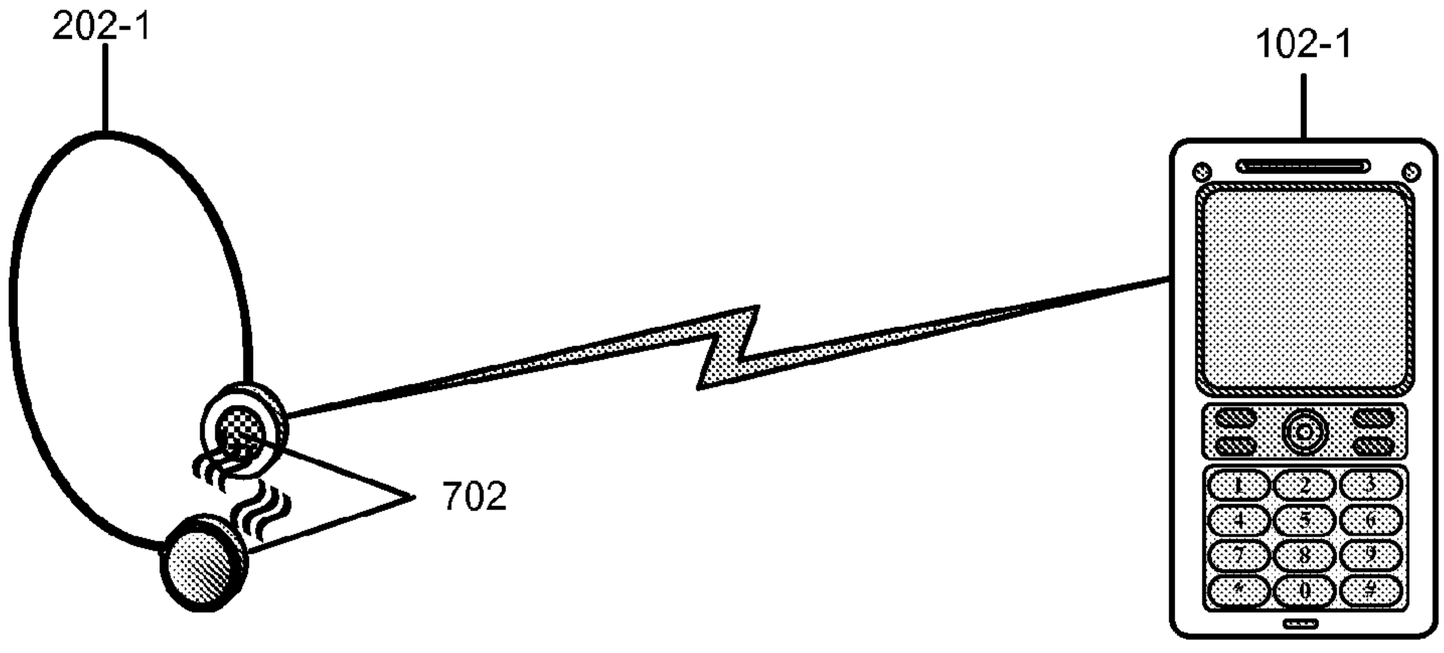

Fig. 8C

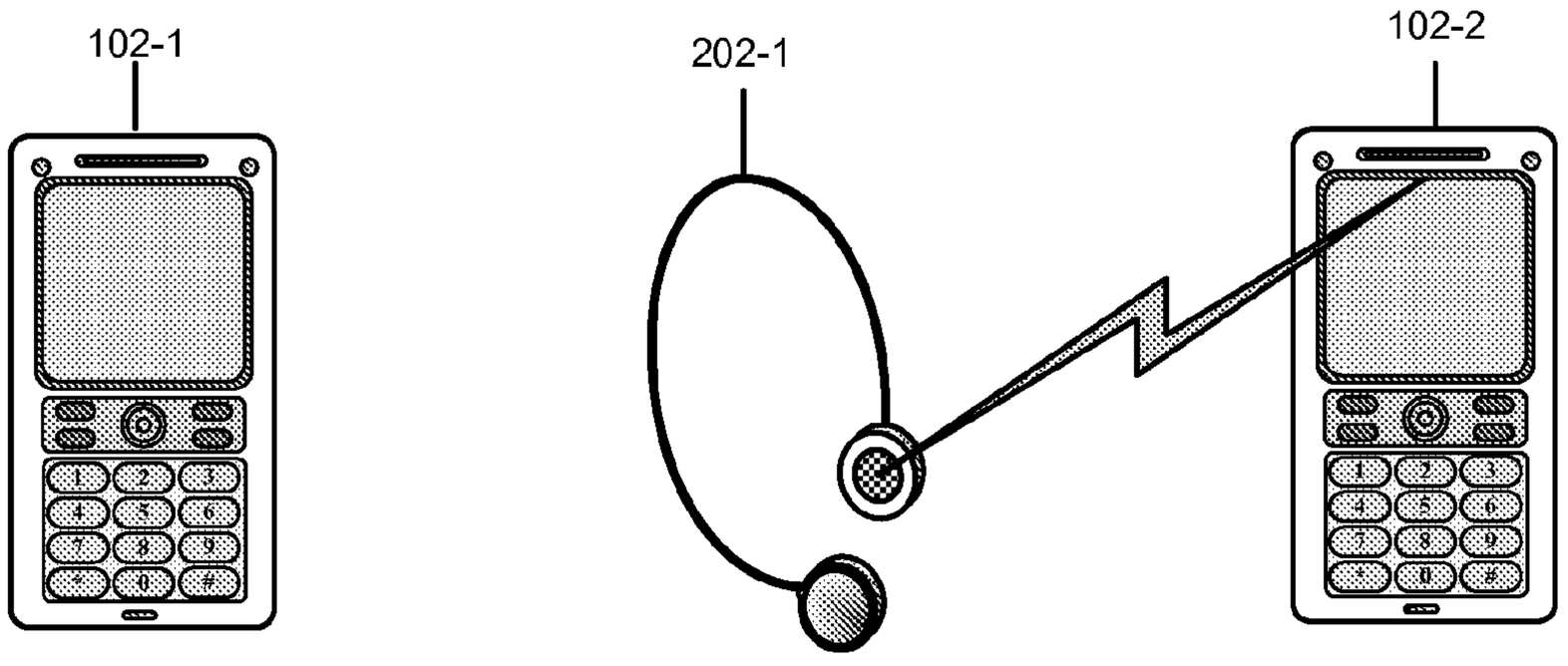

Fig. 8D

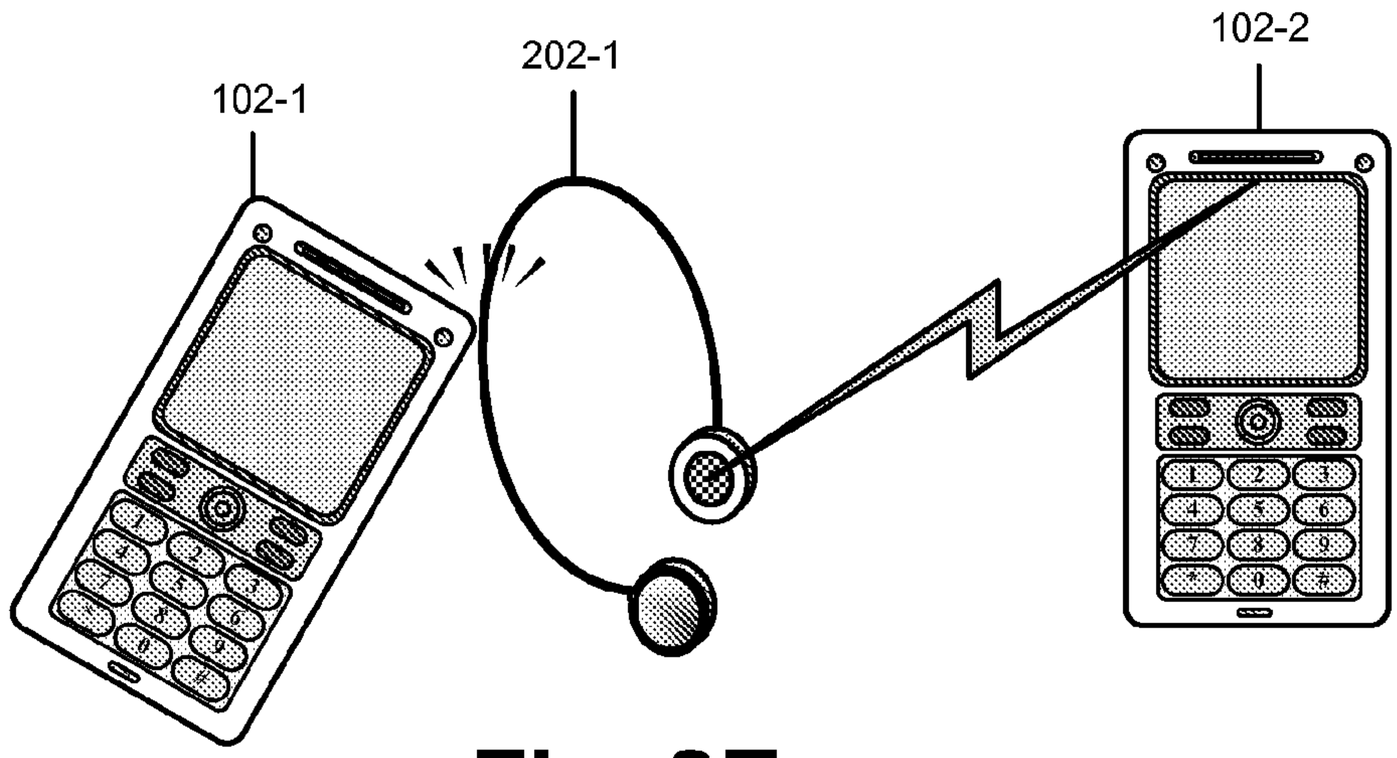

Fig. 8E

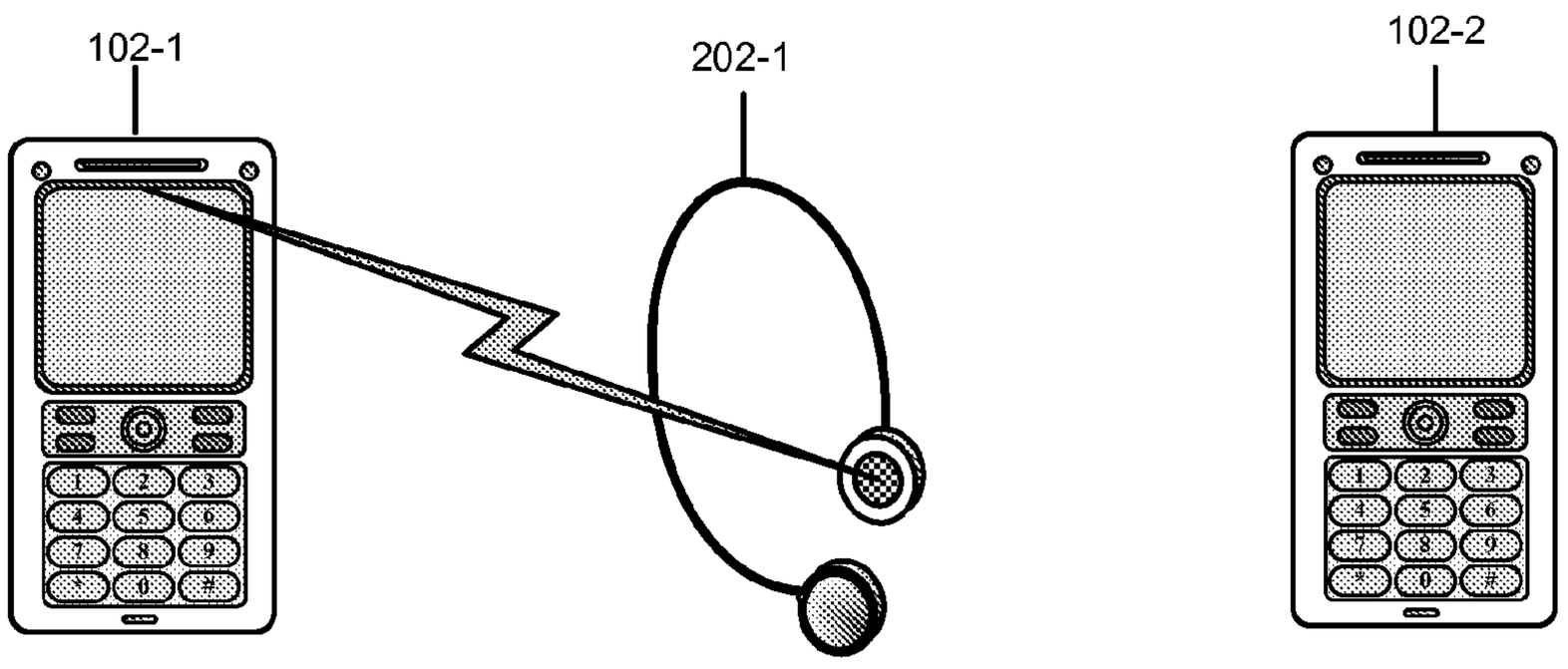

Fig. 8F

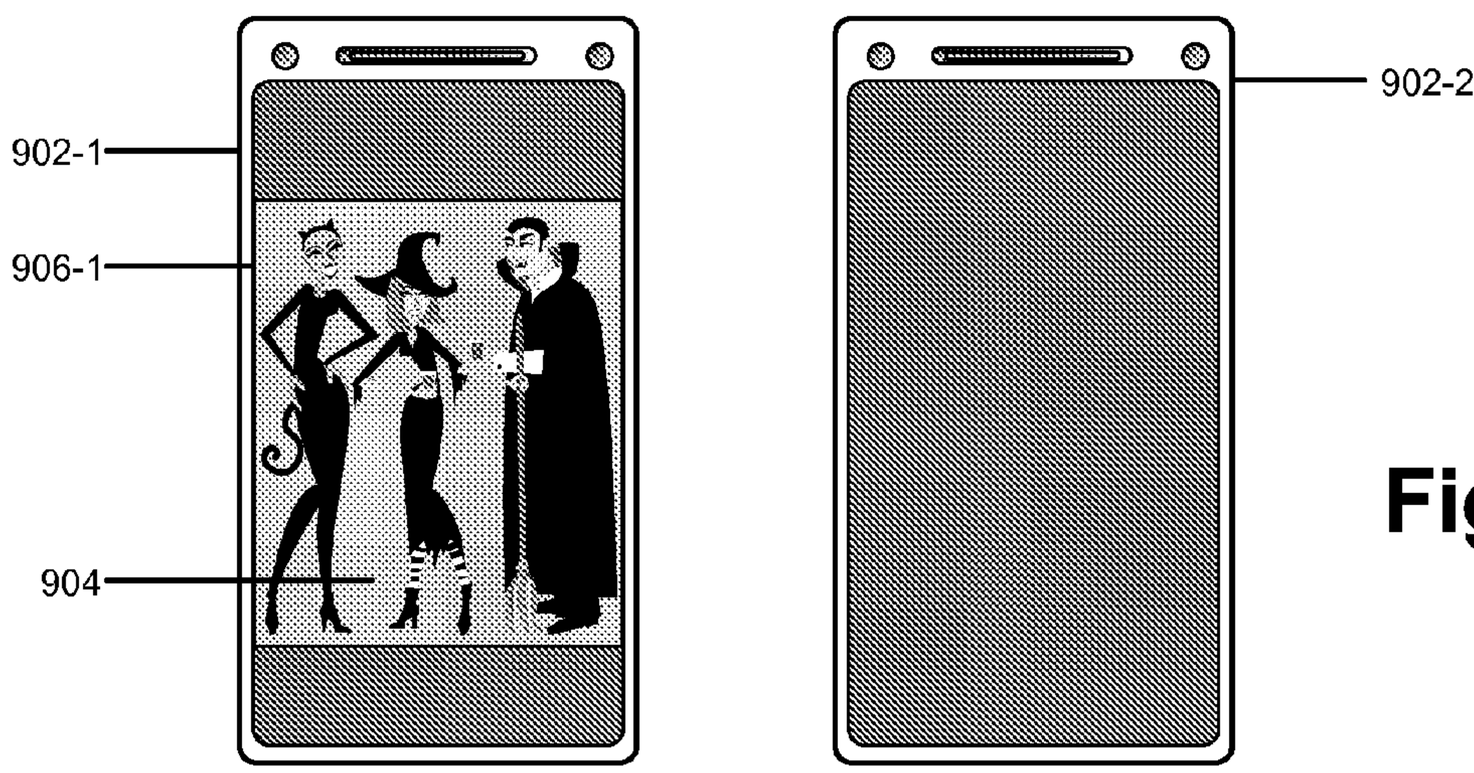

Fig. 9A

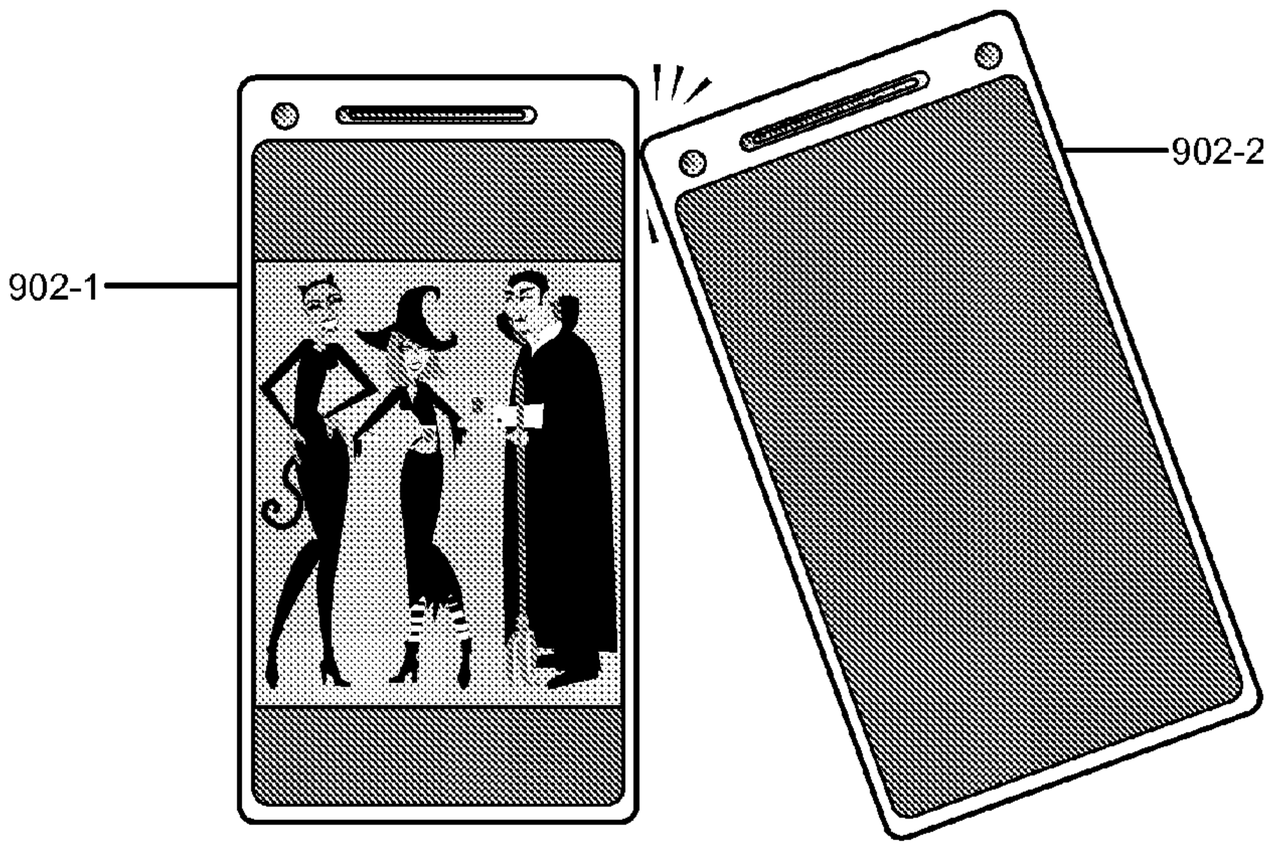

Fig. 9B

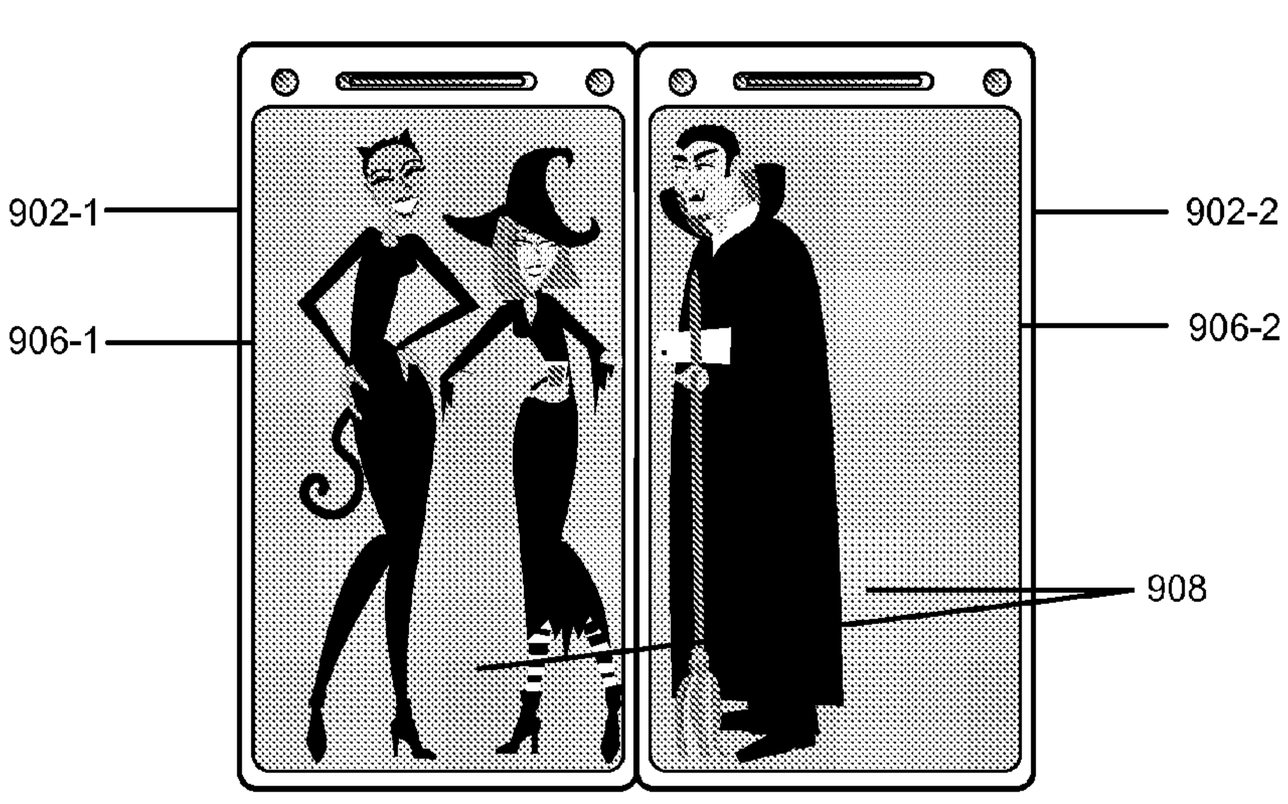

Fig. 9C

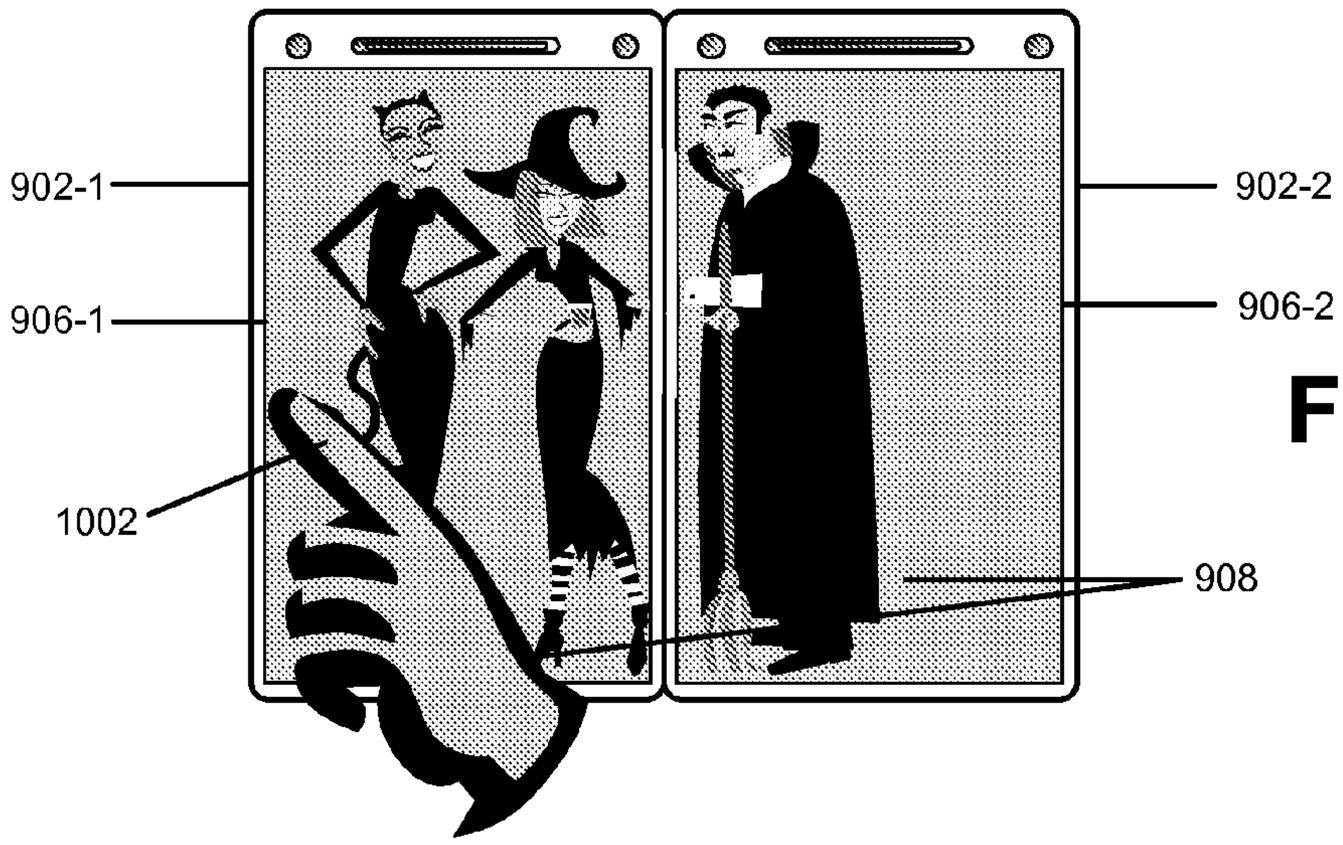

Fig. 10A

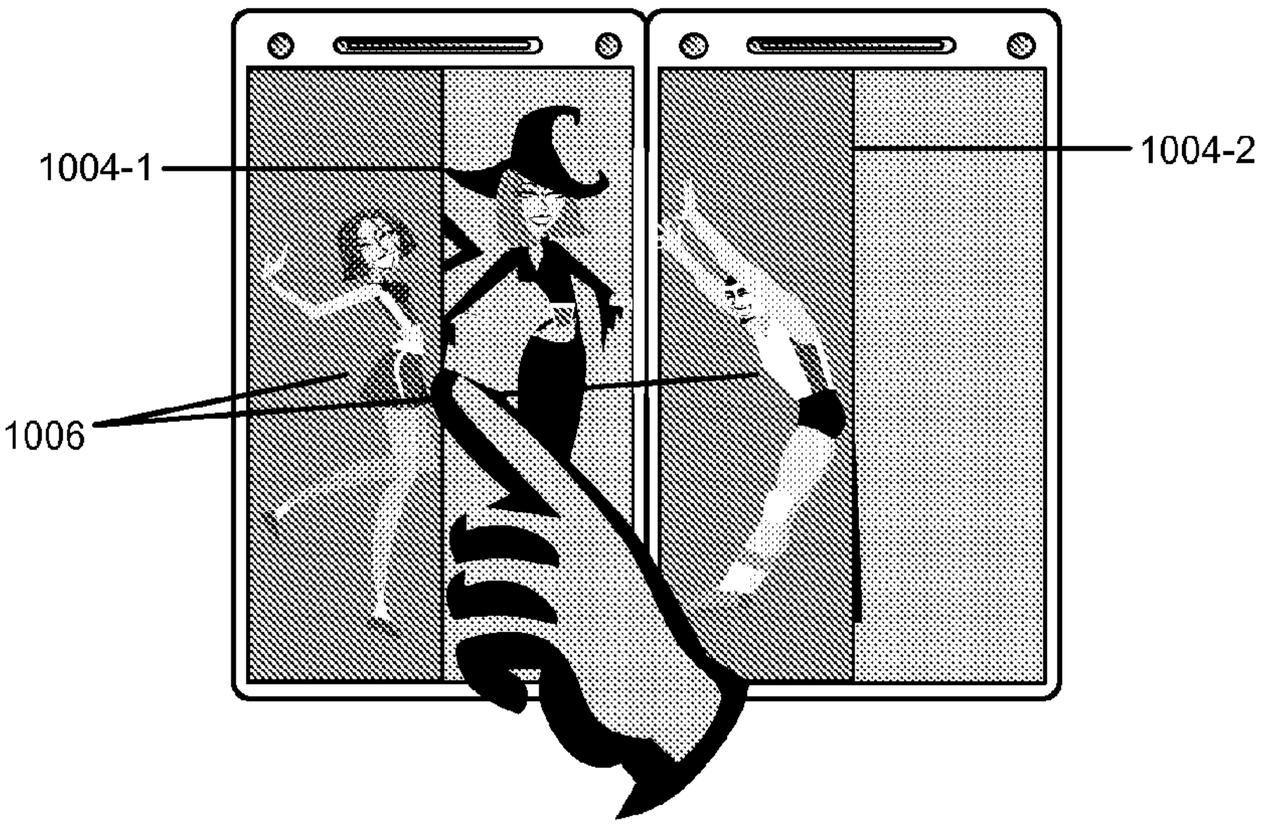

Fig. 10B

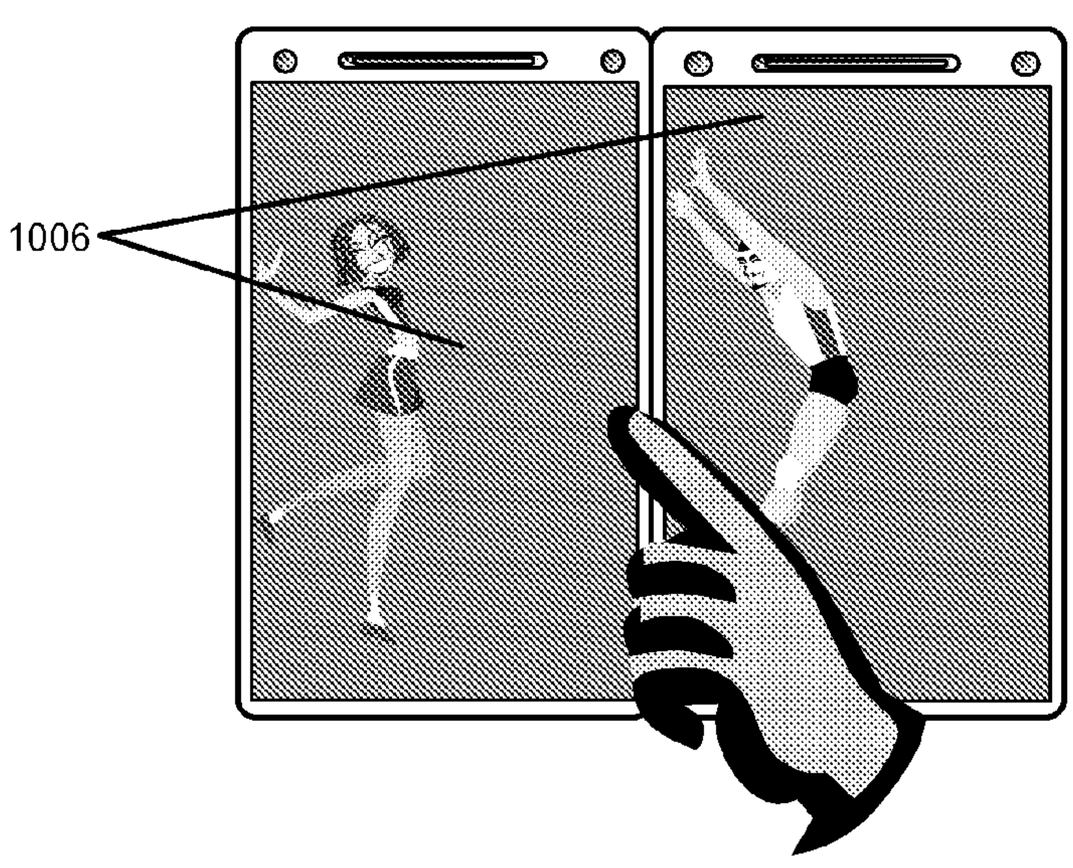

Fig. 10C

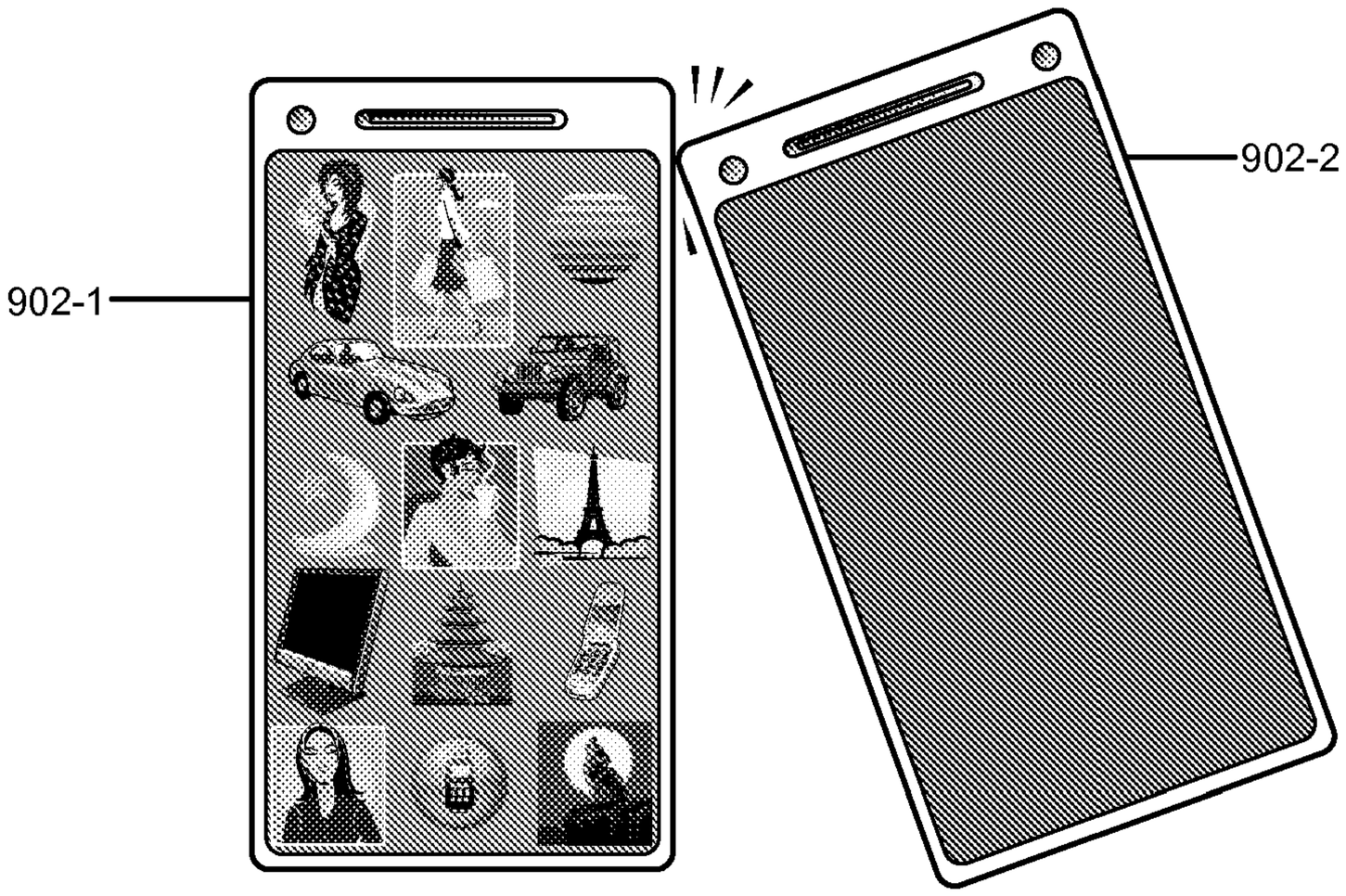

Fig. 11A

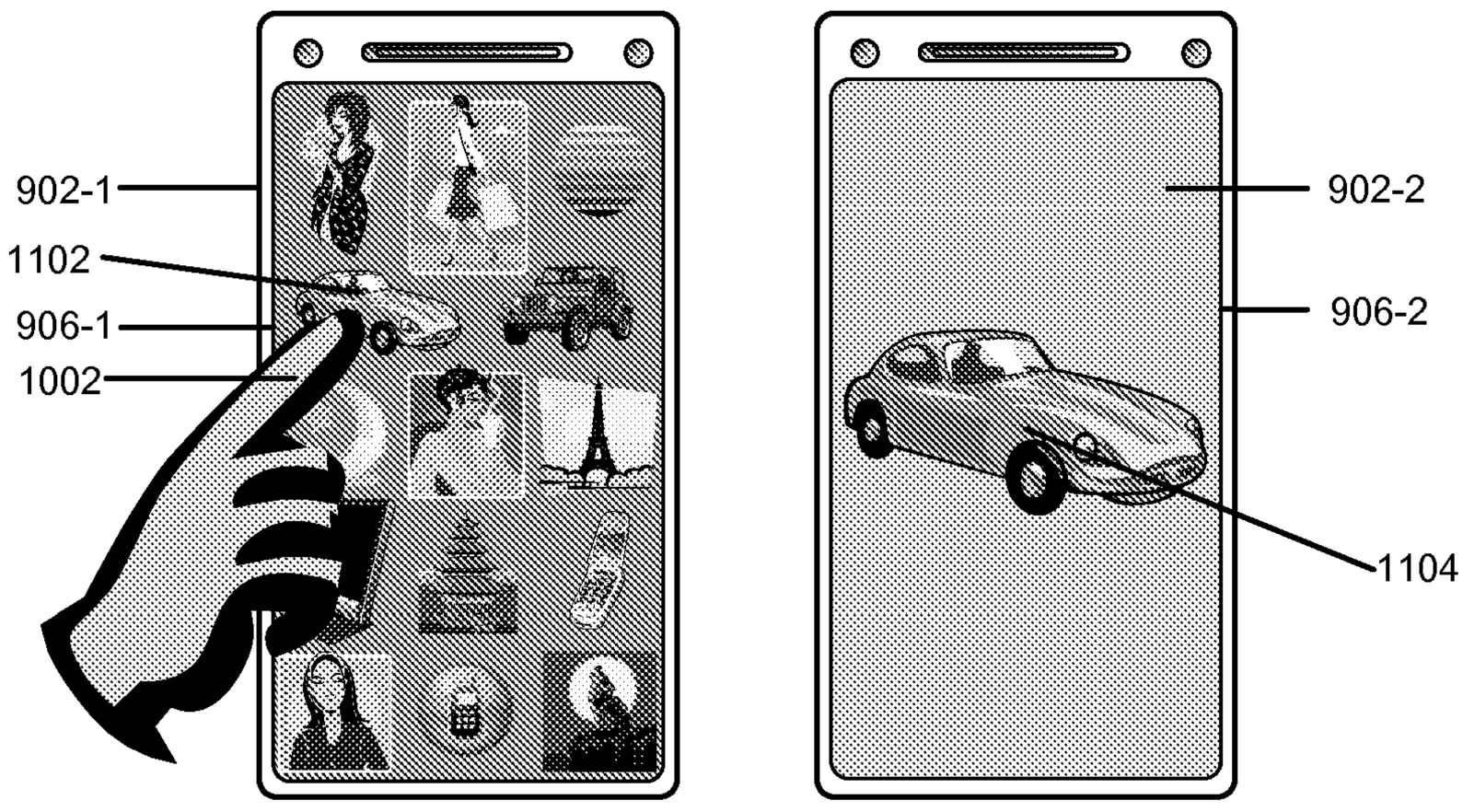

Fig. 11B

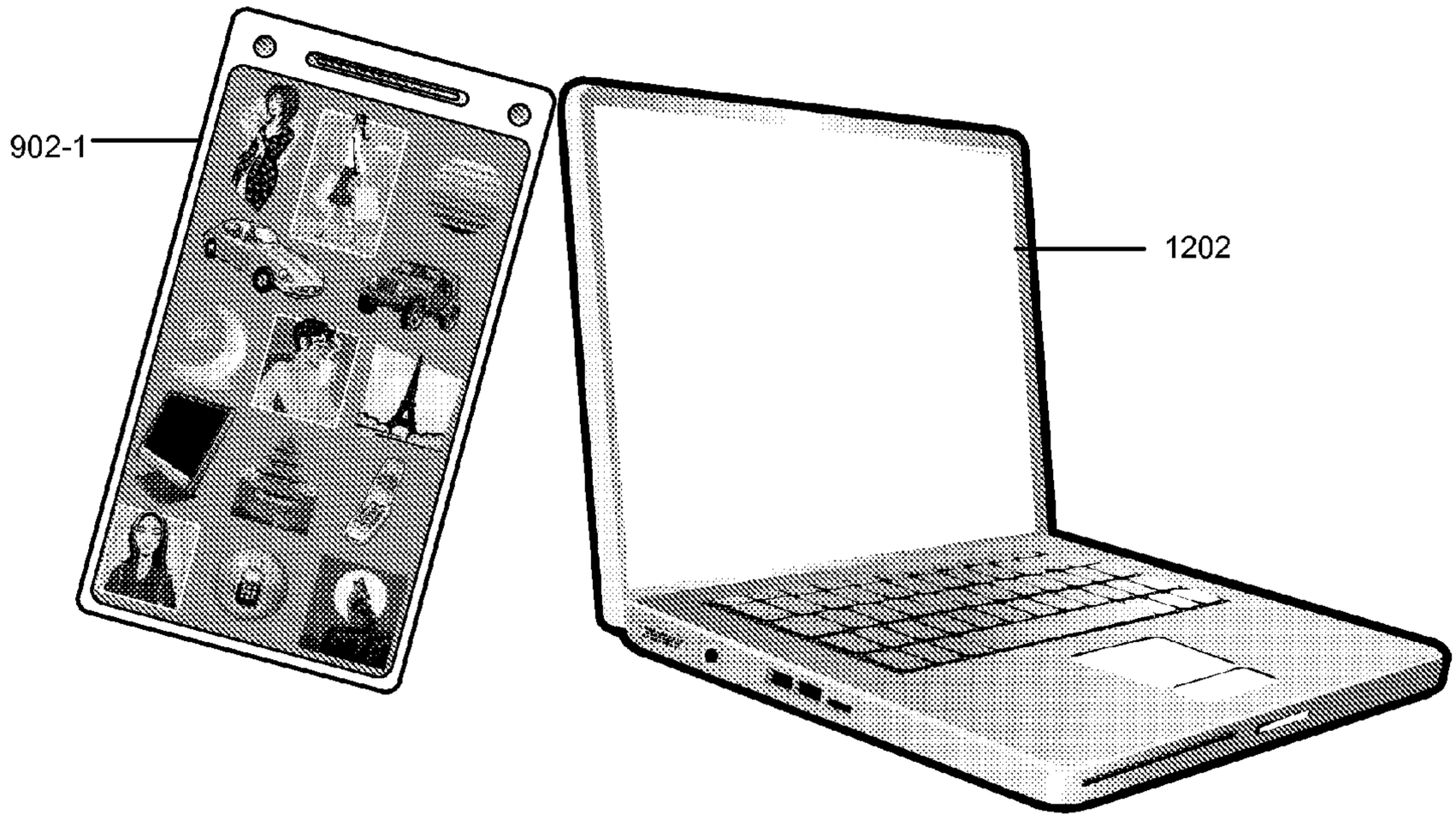

Fig. 12A

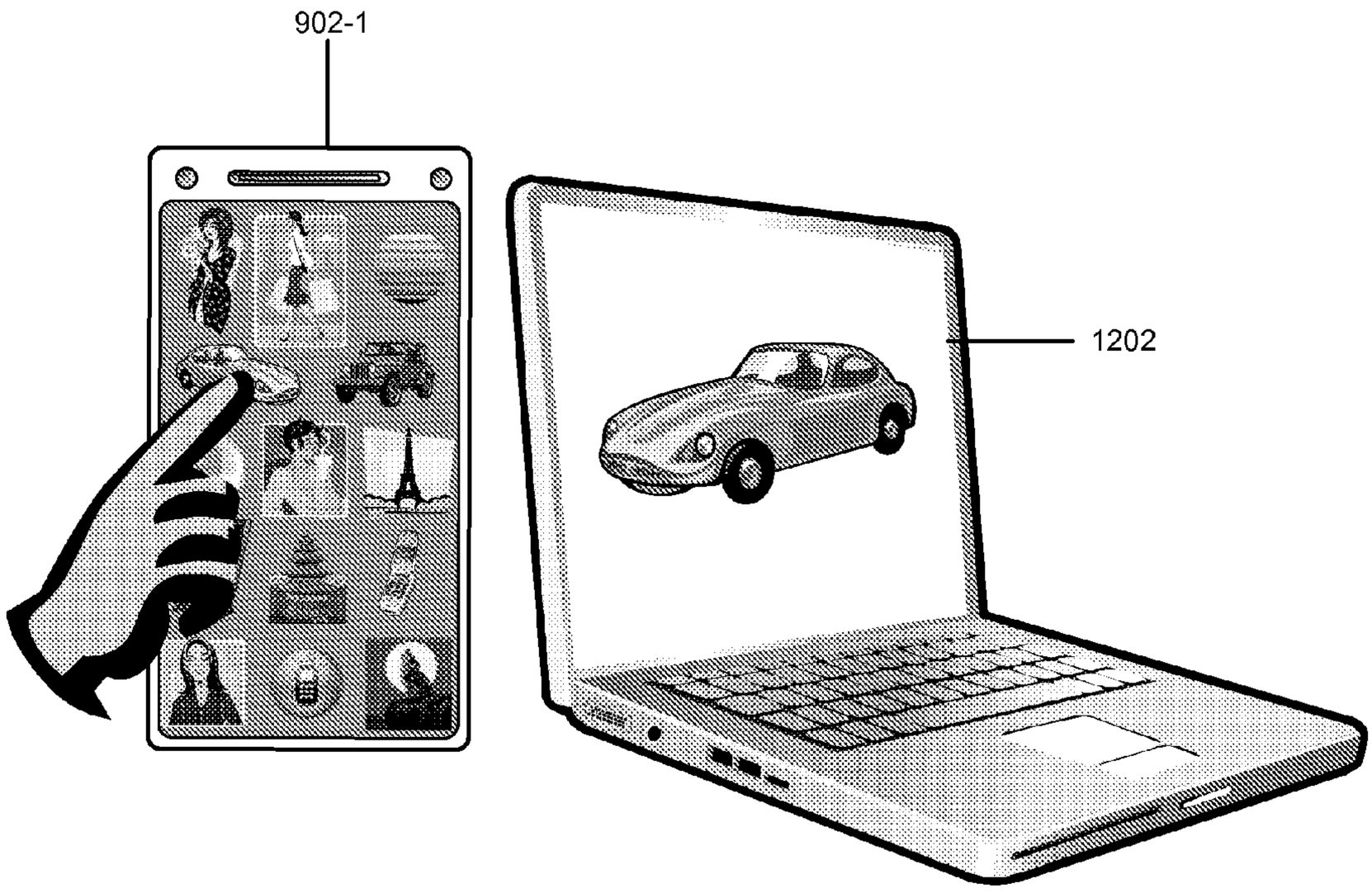

Fig. 12B

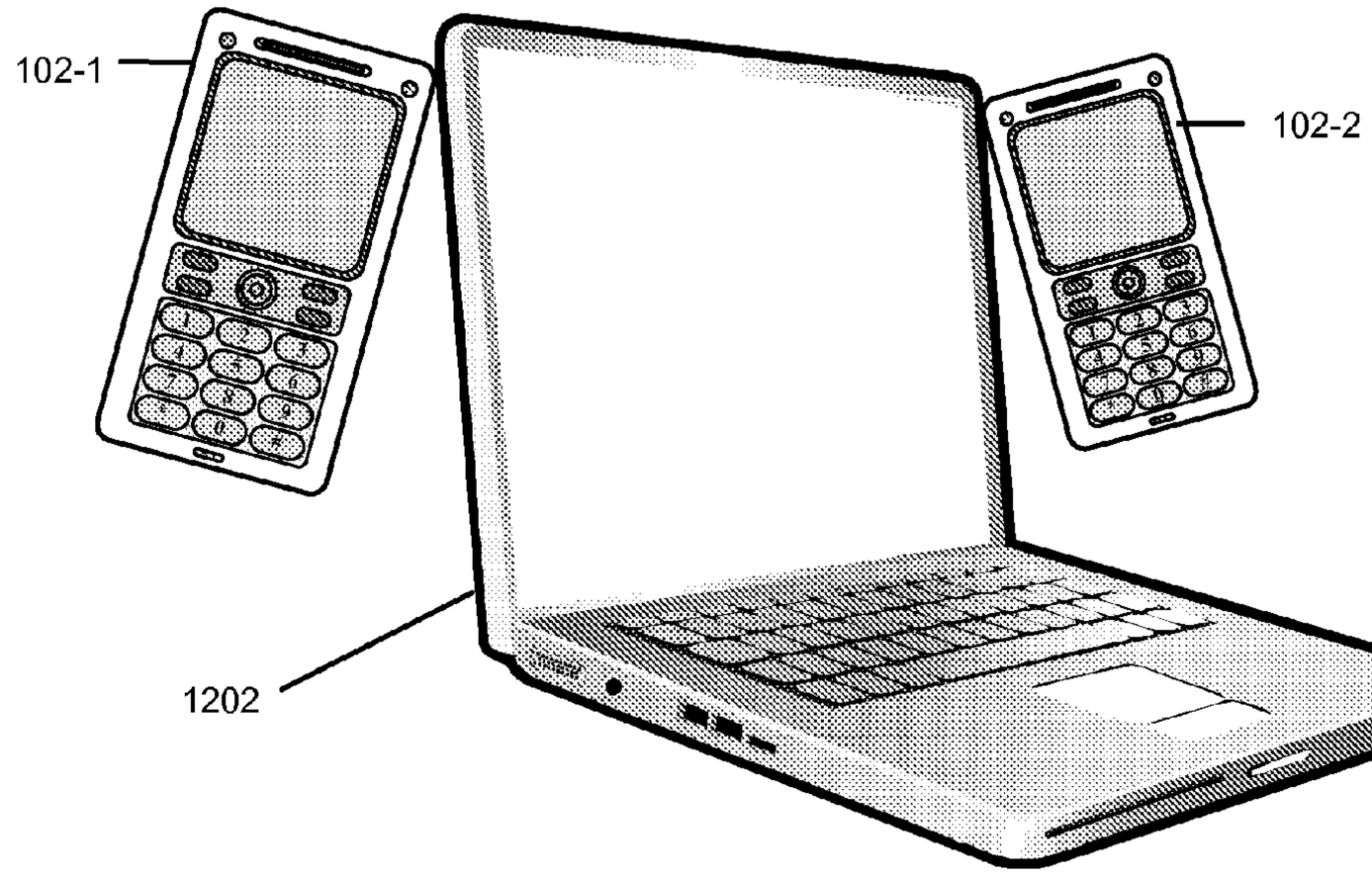

Fig. 13A

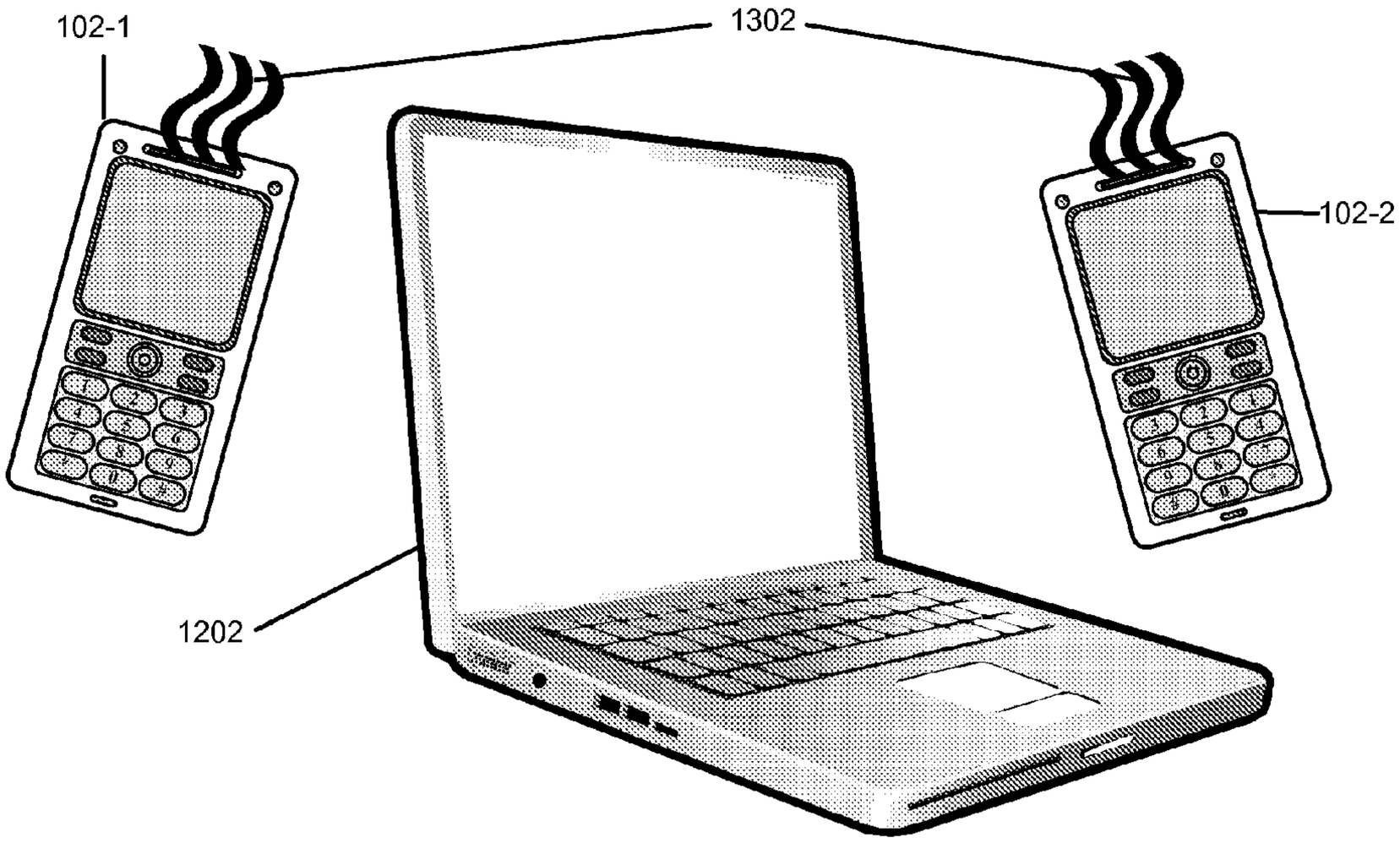

Fig. 13B

INTERACTING WITH DEVICES BASED ON PHYSICAL DEVICE-TO-DEVICE CONTACT

BACKGROUND

[0001] Many computer or communication devices rely on a keyboard or a keypad to provide part of a user interface. However, using the keyboard or keypad is often cumbersome and/or inconvenient. In addition, other devices that use touch screens to emulate a keyboard or a keypad may not provide significant improvements over devices that use a keyboard or a keypad.

SUMMARY

[0002] According to one aspect, a method may include receiving a signal from a sensor coupled to a first device, determining whether the first device is tapped against a second device based on the signal, sending a message to the second device when the first device is tapped against the second device, determining if the taps are valid user input based on a response from the second device, and performing an application specific action when the taps are valid user input.

[0003] Additionally, receiving a signal may include receiving the signal from an accelerometer.

[0004] Additionally, determining whether the first device is tapped against the second device may include determining if samples of the signal match a predetermined acceleration pattern.

[0005] Additionally, sending a message may include obtaining parameters regarding taps that are detected based on the signal, and sending the parameters to the second device.

[0006] Additionally, obtaining parameters may include obtaining locations of the taps on a surface of the first device, determining time between consecutive taps, determining time of occurrence of at least one of the taps.

[0007] Additionally, determining if the taps are valid user input may include receiving the response, the response indicating if the sent parameters match parameters that are obtained from taps on the second device.

[0008] Additionally, determining if the taps are valid user input may include receiving parameters about taps on the second device in response to the message, determining if the received parameters match parameters that are extracted from the signal when the first device is tapped against the second device, and determining whether the taps are valid by comparing the received parameters to the extracted parameters.

[0009] Additionally, performing an application specific action may include coordinating at least one of an audio task or a-visual task with the second device.

[0010] Additionally, performing an application specific action may include one of sending an audio signal to the second device for output by a speaker, or sending a video signal to the second device for display.

[0011] Additionally, performing an application specific action may include at least one of receiving personal contact information from the second device, conducting a commercial transaction with the second device, or receiving a video clip, audio clip, image, or text from the second device.

[0012] Additionally, performing an application specific action may include at least one of terminating a communication session that has been established based on taps between the first device and the second device, or causing the first device to terminate a communication session that has been established prior to taps between the first device and a third device.

[0013] According to another aspect, a device may include a sensor and a processor. The processor may be configured to receive a signal from the sensor, detect taps based on the signal, extract parameters that are associated with the detected taps, send a request to a second device to verify if the extracted parameters match parameters that are obtained from taps by the second device, determine if the detected taps are valid user input based on a response from the second device, and interact with the second device over a communication channel when the taps are valid user input.

[0014] Additionally, the parameters may include at least one of time between consecutive taps, or time of occurrence of a tap.

[0015] Additionally, the sensor may include at least one of an accelerometer or an electric field sensor.

[0016] Additionally, the second device may include at least one of a cell phone with a display or a speaker, a headset, or a laptop.

[0017] Additionally, the device may include a cell phone.

[0018] Additionally, the communication channel may include a Bluetooth communication channel.

[0019] Additionally, the request may include the extracted parameters and the response includes information that indicates whether the extracted parameters match the parameters that are obtained from taps by the second device.

[0020] Additionally, the response may include parameters that are obtained from taps by the second device.

[0021] Additionally, the processor may be further configured to cause the second device to terminate a communication session that has been established prior to detected taps between the second device and a third device, or terminate a communication session that has been established based on detected taps between the first device and the second device.

[0022] According to yet another aspect, a method may include receiving a signal from a sensor coupled to a first device, determining whether the first device is tapped against a second device based on the signal, receiving a message from the second device when the first device is tapped against the second device, determining whether the taps are valid user input based on the message from the second device, and terminating a communication link between the second device and the first device when the taps are valid user input.

[0023] Additionally, the method may further include determining whether the first device is tapped against a third device, receiving a message from the third device when the first device is tapped against the third device, determining whether the taps are valid user input based on the message from the third device, and establishing a communication link between the third device and the first device when the taps are valid user input.

BRIEF DESCRIPTION OF THE DRAWINGS

[0024] The accompanying drawings, which are incorporated in and constitute a part of this specification, illustrate one or more embodiments described herein and, together with the description, explain the embodiments. In the drawings:

[0025] FIGS. **1**A through **1**C illustrate a use of exemplary devices in which concepts described herein may be implemented;

[0026] FIG. **2** shows an exemplary network in which concepts described herein may be implemented;

[0027] FIGS. **3**A and **3**B are front and rear views of an exemplary device of FIG. **2**;

[0028] FIG. **4** is a block diagram of the exemplary device of FIGS. **3**A and **3**B;

[0029] FIG. **5** is a functional block diagram of the exemplary device of FIGS. **3**A and **3**B;

[0030] FIG. **6** is a flow diagram of an exemplary process for establishing communication between and interacting with devices based on device-to-device contacts;

[0031] FIG. **7** illustrates an output of a sensor of FIG. **4**;

[0032] FIGS. **8**A through **8**F illustrate using other exemplary devices in which concepts described herein may be implemented;

[0033] FIGS. **9**A through **9**C illustrate an example of interaction between devices based on physical device-to-device contact;

[0034] FIG. **10**A through **10**C illustrates another example of interaction between devices based on physical device-to-device contact;

[0035] FIGS. **11**A and **11**B illustrate yet another example of interaction between devices based on physical device-to-device contact;

[0036] FIGS. **12**A and **12**B illustrate still another example of interaction between devices based on physical device-to-device contact; and

[0037] FIGS. **13**A and **13**B illustrate still another example of interaction between devices based physical device to-device contact.

DETAILED DESCRIPTION OF EMBODIMENTS

[0038] The following detailed description refers to the accompanying drawings. The same reference numbers in different drawings may identify the same or similar elements. The terms "tap," "knock," and "touch" are interchangeably used herein and they may refer to an impact or a contact an object makes against another object. The impact may cause sufficient change in momentum in the body to allow a sensor, such as an accelerometer, to detect the change. Alternatively, the touch may cause a sensor, such as an electric field sensor, a surface conduction sensor, a pressure/force sensor, etc., to detect a surface contact against another surface.

[0039] In implementations described herein, a device (e.g., a portable phone) may establish a communication link with another device after a user taps the device against the other device. When a user taps the device against the other device, the device may detect the taps and obtain a pattern from the taps. Depending on the pattern, the device and the other device may interact with one another over a communication link. Having devices that communicate/interact with other devices based on taps may be convenient, safe, and/or economical (e.g., no need to navigate through a menu system to communicate/interact with another device, no need to expend energy on having a communication link until taps are detected, or expose the link to spam, virus, and/or other unwanted network data, etc.).

[0040] FIGS. **1**A through **1**C illustrate an example of the above concept. FIGS. **1**A through **1**C show devices **102-1** and **102-2** (e.g., cell phone). Device **102-1** and device **102-2** may include speaker **104-1** and **104-2**, respectively. In addition, each of devices **102-1** and **102-2** may sense presence of one another through a discovery link **106**. Assume that, in the example, device **102-1** is playing a song and generating sound waves **108** via speaker **104-1**.

[0041] When a user taps device **102-2** into device **102-1** (or vice versa), both devices **102-1** and **102-2** may sense the taps and compare the taps to a particular pattern. FIG. **1**B shows device **102-2** being tapped with device **102-1**.

[0042] As further shown in FIG. **1**C, upon determining that the pattern represents user input to play the song on both devices **102-1** and **102-2**, devices **102-1** and **102-2** may establish a communication link **110**. Through communication link **110**, device **102-1** may transmit signals on one of two audio channels for stereo sound to device **102-2**. Consequently, devices **102-1** and **102-2** may output stereo sound signals to speakers **104-1** and **104-2**, which then output sound waves **112** and **114**, respectively.

Exemplary Network and Device

[0043] FIG. **2** shows an exemplary network **200** in which concepts described herein may be implemented. As shown, network **200** may include device **102-1**, a headset **202-1**, a cell phone **202-2**, a display **202-3**, a keyboard **202-4**, wireless access point (WAP) **204**, and network **206**. In addition, depending on implementation, network **200** may include fewer, additional, or different devices than the ones illustrated in FIG. **2**. For example, network **200** may include mobile devices (e.g., a wireless mouse, a mobile telephone accessory, a gaming device, a wearable computing device (e.g., watch), a GPS receiver, a television, etc.), or stationary devices (e.g., a copier machine, a television, etc.) that can communicate with device **102-1** or with each other.

[0044] Device **102-1** may include any of the following devices that have the ability to or are adapted to communicate and interact with another device in close range, such as a radio telephone or a mobile telephone with ultra wide band (UWB) communication capability or Bluetooth capability; a game console or device; a global positioning system (GPS) receiver; a personal communications system (PCS) terminal that may combine a cellular radiotelephone with, data processing, facsimile, and/or data communications capabilities; a wearable computing devices (e.g., calculator-watch); an electronic notepad, a laptop, and/or a personal computer that communicate with wireless peripherals (e.g., a wireless keyboard, speakers, mouse, etc.); a personal digital assistant (PDA) that can include a telephone; or another type of computational or communication device.

[0045] Each of devices **202-1** through **202-4** may include one or more devices that are capable of communicating and/or interacting wirelessly with device **102-1** via, for example, Bluetooth, Wireless Fidelity (Wi-Fi), etc. More specifically, headset **202-1** may receive audio information from device **102-1** and output sound (e.g., songs). Cell-phone **202-2** may perform various functions for device **102-1**, such as providing an audio output device, display, microphone, etc. In one implementation, cell-phone **202-2** may be similarly or identically constructed as device **102-1**. Display **202-3** may show images that are received by device **102-1** and/or may send information that is inputted via a touch-sensitive screen to device **102-1**. Keyboard **202-4** may permit a user to conveniently input alphanumeric and special characters to device **102-1**.

[0046] WAP **204** may include a device for accessing network **206**, such as a router that is able to receive and transmit wireless and/or wired signals, or any other device that provides access to a network. WAP **204** may communicate with device **102-1** using a wireless communication protocol.

[0047] Network **206** may include the Internet, an ad hoc network, a local area network (LAN), a wide area network (WAN), a metropolitan area network (MAN), a cellular network, a public switched telephone network (PSTN), an intranet, any other network, or a combination of networks.

[0048] FIGS. **3**A and **3**B are front and rear views, respectively, of an exemplary device **102-1** in which concepts described herein may be implemented. In this implementation, device **102-1** may take the form of a portable phone (e.g., a cell phone). As shown in FIGS. **3**A and **3**B, device **102-1** may include a speaker **302**, a display **304**, control buttons **306**, a keypad **308**, a microphone **310**, sensors **312**, a lens assembly **314**, and housing **316**. Speaker **302** may provide audible information to a user of device **102-1**. Display **304** may provide visual information to the user, such as an image of a caller, video images, or pictures. Control buttons **306** may permit the user to interact with device **102-1** to cause device **102-1** to perform one or more operations, such as place or receive a telephone call. Keypad **308** may include a standard telephone keypad. Microphone **310** may receive audible information from the user. Sensors **312** may collect and provide, to device **102-1**, information (e.g., acoustic, infrared, etc.) that is used to aid the user in capturing images. Lens assembly **312** may include a device for manipulating light rays from a given or a selected range, so that images in the range can be captured in a desired manner. Housing **316** may provide a casing for components of device **102-1** and may protect the components from outside elements.

[0049] FIG. **4** is a block diagram of exemplary components of device **102-1**. The term "component," as used herein, may refer to hardware component, a software component, or a combination of the two. As shown, device **102-1** may include a memory **402**, processing unit **404**, display **406**, network interface **408**, input/output components **410**, sensor **412**, and communication path(s) **414**. In other implementations, device **102-1** may include more, fewer, or different components.

[0050] Memory **402** may include static memory, such as read only memory (ROM), and/or dynamic memory, such as random access memory (RAM), or onboard cache, for storing data and machine-readable instructions. Memory **402** may also include storage devices, such as a floppy disk, CD ROM, CD read/write (R/W) disc, and/or flash memory, as well as other types of storage devices. Processing unit **404** may include a processor, a microprocessor, an Application Specific Integrated Circuit (ASIC), a Field Programmable Gate Array (FPGA), and/or other processing logic capable of controlling device **102-1**.

[0051] Display **406** may include a component that can display signals generated by device **102-1** as images on a screen and/or that can accept inputs in the form of taps or touches on the screen. For example, display **406** may provide a graphical user interface through which user can interface with device **102-1** to display images or to play music. Examples of display **406** include a liquid crystal display (LCD), organic light-emitting diode (OLED) display, bistable display, and/or a touch screen.

[0052] Network interface **408** may include any transceiver-like mechanism that enables device **102-1** to communicate with other devices and/or systems. For example, network interface **408** may include mechanisms for communicating via a network, such as the Internet, a terrestrial wireless network (e.g., wireless local area network (WLAN)), a satellite-based network, a WPAN, etc. Additionally or alternatively, network interface **408** may include a modem, an Ethernet interface to a local area network (LAN), and/or an interface/connection for connecting device **102-1** to other devices (e.g., a Bluetooth interface). Further, network interface **408** may include one or more receivers, such as a Global Positioning System (GPS) or Beidou Navigation System (BNS) receiver for determining its own geographical location. Input/output components **410** may include a keypad (e.g., keypad **308** of FIG. **2**), a button (e.g., control buttons **306**), a mouse, a speaker (e.g., speaker **302**), a microphone (e.g., microphone **310**), a Digital Video Disk (DVD) writer, a DVD reader, Universal Serial Bus (USB) lines, and/or other types of devices for converting physical events or phenomena to and/or from digital signals that pertain to device **102-1**.

[0053] Sensor **412** may include an accelerometer and/or a contact-sensitive sensor (e.g., an electric field sensor, a surface conduction sensor, a pressure/force sensor, etc.). The accelerometer may include hardware and/or software for determining acceleration of device **102-1**. An example of accelerometer may include a micro electro mechanical system (MEMS) accelerometer or a piezoelectric accelerometer that is coupled to the device housing for measuring device acceleration in one, two, or three axes. In one implementation, when the accelerometer detects acceleration, the accelerometer may output its measurement as three separate values, each of which represents the magnitude of an acceleration component that is parallel to one of coordinate axis. In one implementation, the outputs of the accelerometer may be used to determine taps on the surface of housing **316** of device **102-1**. Sensor **412** may include other accelerometer or motion sensitive devices.

[0054] The contact-sensitive sensor may include hardware and/or software for determining contacts, such as an electric field sensor, a surface conduction sensor, a pressure/force sensor, etc. In one implementation, an electric field sensor or a surface conduction sensor may determine the location of a nearby object or a touching object having a conductive surface. The electric field/surface conduction sensor may generate an electric field or a current at the surface of housing **316**, and may detect changes in its capacitance, electric field, and/or impedance of current paths when the object is close to or is in contact with device **102-1**. In a different implementation, instead of covering most of the surface of housing **316** (e.g., a top corner portion of device **102-1**), the electric field/surface conduction sensor may cover only a small portion of housing **316** that may physically contact or touch another device. In still other implementations, different types of contact-sensitive sensors, such as a vibration sensitive sensor based on piezoelectric material may be used to detect taps, a pressure/force sensor to detect force corresponding to taps, etc.

[0055] Communication path **412** may provide an interface through which components of device **102-1** can communicate with one another.

[0056] FIG. **5** is a functional block diagram of device **102-1**. As shown, device **102-1** may include support logic **502**, a database **504**, a tap detector **506**, and a tap-enabled application **508**. Depending on the particular implementation, device **102-1** may include fewer, additional, or different types of functional blocks than those illustrated in FIG. **5**.

[0057] Support logic **502** may be included in processing unit **404** and/or memory **402**, and may include hardware and/or software for performing various support functions for other components in FIG. **5** (e.g., database **504**, a tap detector **506**, etc.). For example, support logic **502** may provide a

Transmission Control Protocol (TCP)/Internet Protocol (IP) stack to support communications between tap-enabled applications **508** on different devices.

[0058] Database **504** may be included in memory **402** (FIG. **4**) and may act as an information repository for the components of device **102-1**. For example, in one implementation, database **504** may store data that may be used to identify tap patterns that are obtained from processing unit **404** and/or sensor **412**. As an example, a tap pattern may correspond to two taps in a relatively short period of time (e.g., one second).

[0059] In some implementations, a user may associate a specific tap pattern (e.g., a tap pattern that has 3 taps) with an application and store the association in database **504**. For example, 3 taps may be associated with an application for sharing music between different devices, 2 taps may be associated with sharing a picture, etc.

[0060] Tap detector **506** may include a component for detecting a particular tap pattern based on inputs from sensor **412**. For example, tap detector **506** may determine acceleration of device **102-1** as a function of time based on outputs of sensor **412**, and may obtain a pattern of taps from the acceleration. Tap detector **506** may compare the obtained pattern against stored patterns in database **504**. If tap detector **506** finds a match, tap detector **506** may convey that device **102-1** has detected valid user input to another component in device **102-1**, such as tap-enabled application **508**. In a different implementation, when tap detector **506** obtains a pattern of taps, tap detector **506** may notify a nearby device about the pattern. The nearby device may compare the pattern against a pattern that the nearby device has detected, and if there is a match, may convey that the valid user input has been detected to tap-enabled application **508** on device **102-1**.

[0061] In some implementation, when tap-detector **506** determines that the valid user input is detected, tap-detector **506** may convey the detected pattern to a specific tap-enabled application **508**. For example, if 3 taps are detected, tap-detector **506** may start a music sharing application and convey the information to the music sharing tap-enabled application **508**; if 2 taps are detected, tap detector **506** may start an image sharing tap-enabled application **508**, etc. As explained above with respect to database **504**, a user may configure which pattern is associated with which application.

[0062] Tap-enabled application **508** may include a component for receiving an output from tap detector **506** (e.g., an indication that valid input is detected). In addition, tap-enabled application **508** may initiate or terminate communication with another device with which device **102-1** has been tapped, and may interact with the other device. For instance, in the example illustrated in FIG. **1**A through FIG. **1**C, tap-enabled application **508** in device **102-1** may cause each of speakers **104-1** and **104-2** in device **102-1** and device **102-2** to output each of two channels of stereo audio signals. In another instance, in FIG. **2**, when device **102-1** is tapped against device **202-3**, tap-enabled application **508** in device **102-1** may cause device **102-1** and device **202-3** to terminate their communication.

[0063] Examples of different types of tap-enabled application **508** may include: an application for transferring a piece of information (e.g., an electronic payment, coupon, contact information, image, piece of music, text, etc.) between two devices that have been tapped against one another; an application for sharing a task between the devices (e.g., outputting stereo audio signal to different speakers on different devices); an application for selecting a particular device that has been tapped as an input/output device (e.g., a wireless display, a keyboard, a computer, or a television for displaying images/video and/or playing audio output), etc. If a tap-enabled application **508** is implemented to share a file with another application in a different device, tap-enabled application **508** may determine how to layout a picture, video, text, web document, and/or other media content across multiple screens.

[0064] In some implementations, the functionalities of tap detector **506** may be incorporated in tap/enabled application **508**.

Exemplary Process for Interacting with Devices Based on Physical Device-to-Device Contact

[0065] FIG. **6** shows an exemplary process **600** for establishing communication between and interacting with various devices based on device-to-device contact. Process **600** may begin at block **602**, where sensor **412** of device **102-1** may be monitored (block **602**). Monitoring sensor **412** may entail processing unit **404** sampling outputs of sensor **412**. In one implementation, sensor **412** may begin to monitor device **102-1** for taps when one of control buttons **306** or a key on keypad **308** is pressed. Such an implementation may facilitate saving power.

[0066] FIG. **7** shows outputs of sensor **412** when sensor **412** is implemented as an accelerometer. As shown, each of local peaks **702** may indicate a sudden change in acceleration of device **102-1**, and therefore, may indicate a potential tap.

[0067] It may be determined whether samples of outputs of sensor **412** indicate a presence of taps (block **604**). In one implementation, database **504** may store reference output patterns of sensor **412** of device **102-1** when device **102-1** is tapped. The patterns may be compared against the samples, and if the samples match one or more of the patterns, tap detector **506** may determine that device **102-1** is tapped. In another implementation, tap detector **506** may perform a test on the samples (e.g., determine if one or more peaks are greater than a threshold) to determine the presence of one or more taps. In a different implementation, a tap may be detected by sensor **412** (e.g., changes in acceleration), and subsequently, device **102-1** may monitor sensor **412** for another tap within a particular amount of time (e.g., 2 seconds). If no tap is detected, device **102-1** may enter into an idle mode; otherwise process **600** may proceed to block **606**.

[0068] When taps are determined as being present, parameters that are associated with the taps may be obtained (block **606**). The parameters may include the number of taps, time between consecutive taps, physical locations of the taps on housing **316** of device **102-1**, time at which each tap occurs, the orientation of device **102-1**, etc. If sensor **412** includes an accelerometer, the locations of the taps may be determined based on the direction of acceleration of device **102-1** during the taps. Alternatively, if sensor **412** is implemented as an electric field sensor, sensor **412** may determine and output the locations of the taps. In another implementation, specific portions of housing **316** may be coupled to a contact-sensor, and each portion may be associated with a physical location on the surface of housing **316**. In such an implementation, detecting taps on one of the portions may indicate the locations of the taps. In some implementations, a gyroscope/magnetometer may be included to obtain the orientation of device **102-1** as one of the parameters.

[0069] Whether the taps are a valid input may be determined based on the parameters (block **608**). When the taps

correspond to a valid input, another device that is used together with the device to produce the taps may be identified (block **608**). Depending on the implementation, block **608** may be performed in a number of ways. For example, in one implementation, tap detector **506** may communicate with all nearby devices to determine which device has been recently tapped. Consequently, each of the nearby devices may determine whether it has been tapped in a similar manner to that described above with respect to device **102-1**. If a nearby device has been tapped, the nearby device may transmit parameters (e.g., time between two consecutive taps) that characterize its own taps to device **102-1**. Tap detector **506** in device **102-1** may compare the received parameters to the parameters that are obtained at block **606**. If they match, tap detector **506** may conclude that the taps represent valid user input and identify the nearby device as the other device that has been used to produce the taps.

[0070] In a different implementation, device **102-1** may broadcast the parameters and/or tap patterns to nearby tap-enabled devices. Each of the nearby tap-enabled devices may attempt to match the received parameters and/or the tap patterns to its own parameters and/or tap patterns. If there is a match, the nearby device may communicate with device **102-1** to identify itself and to indicate that the taps are valid user input. For example, the nearby device may signal device **102-1** with one or more beeps (e.g., two beeps) indicating a pairing of the two devices.

[0071] In different implementations, either device **102-1** or the nearby device may initiate the determination whether the taps are valid input and/or identify itself to the other device.

[0072] In one implementation, matching the parameters may involve matching the physical locations of the taps on device **102-1** and on other devices. For example, assume that device **102-1** is tapped simultaneously by two or three nearby devices. In such an implementation, a user may indicate which of the nearby devices may receive what information from device **102-1** by tapping device **102-1** with each of the nearby devices on predetermined locations of housing **316**. For example, the user may tap device **102-1** with a device that is to operate as a right speaker on the right side of housing **316** of device **102-1**.

[0073] In the above implementations, validating the taps as user input may involve establishing a communication between device **102-1** and other devices via a wireless network (e.g., piconet). In one implementation, when the taps are detected, device **102-1** and another device may connect via Bluetooth or WiFi, search for a temporary, unique network identifier (e.g., a name configured using an encryption algorithm in both devices), and use one of the parameters (e.g., time between two consecutive taps) as a unique password/key to establish a connection with one another. Once a communication is established, device **102-1** and the other device may retake or use their original device names or network identifiers. In a different implementation, validating the taps may involve causing a nearby device that is already in communication with device **102-1** to respond with one or more of the parameters or to validate the taps in any number of different ways.

[0074] Interaction with the other device may be performed (block **610**). After device **102-1** determines that the taps are valid user input and identifies the other device used to produce the taps, tap-enabled application **508** in either device **102-1** or the other device may establish or terminate communication with one another. The interaction between the devices may depend on specifics of tap-enabled application **508** on device **102-1** and/or the other device, as illustrated in the examples described below. For example, if device **102-1** already has established a communication link with the other device, device **102-1** and the other device may terminate the communication link, interpreting taps as a cue or signal to decouple device **102-1** and the other device.

[0075] In some implementations, a process for establishing communication between and interacting with different devices based on taps may involve more than two devices. For example, in one implementation, devices **102-1** and **102-2** may be used in conjunction with a laptop. Tapping each of two devices **102-1** and **102-2** to different sides of the laptop may enable devices **102-1** and **102-2** to operate as a right-hand speaker and a left-hand speaker for the laptop.

Examples

[0076] FIGS. **8**A-**8**F, **9**A-**9**C, **10**A-**10**C, **11**A-**11**B, **12**A-**12**B, and **13**A-**13**B illustrate processes involved in interacting with various devices based on physical device-to-device contact. The example is consistent with exemplary process described above with respect to FIG. **6**.

[0077] FIGS. **8**A through **8**C illustrate an example in which device **102-1** selects a peripheral for an audio output. In FIG. **8**A, assume that acceleration of device **102-1** is being monitored via sensor **412**. Signals from sensor **412** are used to determine if taps are present, and when, as illustrated in FIG. **8**B, device **102-1** is tapped with headset **202-1**, tap detector detects **506** the taps. Furthermore, parameters that are associated with the taps are obtained, and sent to headset **202-1**. Headset **202-1** confirms that the taps are a valid input (e.g., matches the parameters to those related to taps that are detected by headset **202-1**), and sends the confirmation to device **102-1**. Upon receiving the confirmation, tap-enabled application **508** in device **102-1** channels an audio output to headset **202-1**, which plays the audio output via speakers **702**, as illustrated in FIG. **8**C.

[0078] In the example, instead of selecting a particular peripheral based on a menu system, the user may select headset **202-1** to use with device **102-1** by simply tapping headset **202-1** to device **102-1**.

[0079] FIGS. **8**D through **8**F illustrate an example in which device **102-1**, headset **202-1**, and device **102-2** interact. In FIG. **8**D, assume device **102-2** has established a wireless communication with headset **202-1**. In addition, assume that another user that owns device **102-1** wishes to temporarily borrow headset **202-1**.

[0080] As illustrated in FIG. **8**E, when device **102-1** is tapped with headset **202-1**, tap detector **506** in headset **202-1** and/or device **102-1** detects the taps. Parameters that are associated with the taps are obtained by headset **202-1** and device **102-1**, exchanged, and used to confirm (by either headset **202-1** or device **102-1**) that the taps are valid input (e.g., matches the parameters to those related to taps that are detected by either headset **202-1** or device **102-1**). Upon the confirmation, tap-enabled application **508** in headset **202-1**/device **102-2** terminates a communication link between headset **202-1** and device **102-2**. Furthermore, headset **202-1** and device **102-1** begin a communication session with each other, as illustrated in FIG. **8**F.

[0081] In a different implementation, when headset **202-1** is tapped against device **102-2** (or vice versa), headset **202-1** and device **102-2** terminate the communication between headset **202-1** and device **102-2**. When a user taps headset

202-1 against 101-1, headset 202-1 and device 101-1 start a new communication session with one another.

[0082] Switching between different peripherals and/or I/O devices in the manner described above may be convenient and easy for users. Furthermore, such switching may avoid multi-point connections that require significantly more power to maintain.

[0083] FIGS. 9A through 9C illustrate another example of interaction between devices based on physical device-to-device contact. As shown in FIG. 9A, the example involves a cell-phone like devices 902-1 and 902-2, which are different implementations of device 102-1. In the example, device 902-1 shows a photograph 904 on display 906-1.

[0084] As shown in FIG. 9B, device 902-2 is tapped against device 902-1. When device 902-2 is tapped against device 902-1, device 902-1 confirms that the taps are valid user input and identifies device 902-2 as the device that has been used to produce the taps. Thereafter, tap-enabled application 508 in device 902-1 uses display screen 906-1 on device 902-1 and display screen on 906-2 on device 902-2 to show enlarged picture 908 that expands the original image to span portions of both screens 906-1 and 906-2.

[0085] FIG. 10A through 10C illustrates yet another example of interaction between devices based on physical device-to-device contact. As shown in FIG. 10A, devices 902-1 and 902-2 show picture 908 on displays 906-1 and 906-2. Assume that a user wishes to switch from picture 908 to a second picture. To switch from picture 908 to another picture, the user places a finger 1002 on a side edge of display 906-1.

[0086] As shown in FIG. 10B, the user then sweeps finger 1002 across the surface of display 906-1 from the side edge toward the center of display 906-1. As finger 1002 sweeps the surface of display 906-1, a line 1004-1 at the side edge follows the finger to the position illustrated in FIG. 10B, revealing a portion of picture 1006. In addition, tap-enabled application 508 sends information related to finger 1002 and line 1004-1 to device 902-2, which causes line 1004-2 in display 904-2 to track line 1004-1. Movement of line 1004-2 reveals a different portion of picture 1006 on display 906-2.

[0087] FIG. 10C illustrates display 906-1 and 906-2 when finger 1002 completes its sweep across display 906-1. As illustrated, displays 906-1 and 906-2 show picture 1006.

[0088] FIGS. 11A and 11B illustrate yet another example of interaction between devices based on physical device-to-device contact. As illustrated in FIG. 11A, the example involves devices 902-1 and 902-2. In addition, display 906-1 of device 902-1 shows a screen full of thumbnail images in accordance with another implementation of tap-enabled application 508. In the example, devices 902-1 and 902-2 are tapped together, as in the previous examples.

[0089] When device 902-2 is tapped against device 902-1, device 902-1 confirms that the taps are valid user input and identifies device 902-2 as the device that has been used to produce the taps. Subsequently, when the user touches a thumbnail image 1102 with finger 1002 as shown in FIG. 11B, tap-enabled application 508 sends another image 1104 related to thumbnail image 1102 to device 902-2. Device 902-2 displays image 1104. In a different implementation, device 902-2 may access image 1104 from its own memory 402 or from a network.

[0090] FIGS. 12A and 12B illustrate yet another example of interaction between devices based on physical device-to-device contact. The example is similar to the example illustrated by FIGS. 11A and 11B, except that, in place of device 902-2, device 1202 (e.g., a laptop) is used.

[0091] FIGS. 13A and 13B illustrate still another example of interaction between devices based on physical device to-device contact. As shown in FIG. 13A, devices 102-1 and 102-2 are tapped against device 1202, whose tap-enabled application 508 is playing music. When devices 102-1 and 102-2 are tapped against device 1202, a process similar to those described above for different examples is performed. In addition, device 1202 sends each of audio signals that are associated with stereo sound to devices 102-1 and 102-2, respectively. Devices 102-1 and 102-2 may then act as left and right speakers for device 1202. Depending on the implementation, devices 102-1 and 102-1 may play the audio signals within a particular amount of time after the taps (e.g., 1 second after the taps). In some implementations, devices 102-1, 102-1, and 1202 may show coordinated music visualization graphics (e.g., waves).

[0092] The above example shows that causing a device to communicate with another device and/or interact with the other device based on taps may be convenient (e.g., there is no need for a user to navigate through a menu system on display 304), safe, (e.g., a communication link between the devices is not exposed to computer virus, spam, and/or other unwanted network data/messages until the taps are detected), and/or economical (e.g., no need to expend energy on maintaining a communication link until taps are detected).

CONCLUSION

[0093] The foregoing description of implementations provides illustration, but is not intended to be exhaustive or to limit the implementations to the precise form disclosed. Modifications and variations are possible in light of the above teachings or may be acquired from practice of the teachings.

[0094] For example, while a series of blocks has been described with regard to an exemplary process illustrated in FIG. 6, the order of the blocks may be modified in other implementations. In addition, non-dependent blocks may represent acts that can be performed in parallel to other blocks.

[0095] In yet another example, tap-enabled application 508 may send different types of information to tapped devices, such as information related to transferring electronic payment/cash, coupons, contact information, images, pieces of music (e.g., songs), text, etc. In some implementations, specific location of the taps may determine what information is transferred. For example, if device 102-1 is tapped on a side, device 102-1 may send a picture, and if device 102-1 is tapped on the top near speaker 302, device 102-1 may share a song with another device.

[0096] It will be apparent that aspects described herein may be implemented in many different forms of software, firmware, and hardware in the implementations illustrated in the figures. The actual software code or specialized control hardware used to implement aspects does not limit the invention. Thus, the operation and behavior of the aspects were described without reference to the specific software code—it being understood that software and control hardware can be designed to implement the aspects based on the description herein.

[0097] It should be emphasized that the term "comprises/comprising" when used in this specification is taken to specify the presence of stated features, integers, steps or

components but does not preclude the presence or addition of one or more other features, integers, steps, components, or groups thereof.

[0098] Further, certain portions of the implementations have been described as "logic" that performs one or more functions. This logic may include hardware, such as a processor, an application specific integrated circuit, or a field programmable gate array, software, or a combination of hardware and software.

[0099] Even though particular combinations of features are recited in the claims and/or disclosed in the specification, these combinations are not intended to limit the invention. In fact, many of these features may be combined in ways not specifically recited in the claims and/or disclosed in the specification.

No element, act, or instruction used in the present application should be construed as critical or essential to the implementations described herein unless explicitly described as such. Also, as used herein, the article "a" is intended to include one or more items. Where one item is intended, the term "one" or similar language is used. Further, the phrase "based on" is intended to mean "based, at least in part, on" unless explicitly stated otherwise.

1. (canceled)

2. The method of claim **23**, where receiving a signal includes:

receiving the signal from an accelerometer,

the method further comprising:

determining whether the first device is tapped against the second device,

where determining whether the first device is tapped against the second device includes:

determining if samples of the signal match a predetermined acceleration pattern.

3. (canceled)

4. The method of claim **23**, where sending the message includes:

sending the extracted parameters to the second device.

5. The method of claim **23**, where extracting the parameters includes:

obtaining locations of the taps on a surface of the first device;

determining time between consecutive taps; or

determining time of occurrence of at least one of the taps.

6. The method of claim **4**, where determining if the detected taps are valid user input includes:

receiving the response, the response indicating whether the extracted parameters match the parameters that are obtained from the taps on the second device.

7. The method of claim **23**, where determining if the detected taps are valid user input includes:

determining if the parameters, included in the response, match the parameters that are extracted from the signal, when the first device is tapped against the second device; and

determining whether the taps are valid by comparing the parameters, included in the response, to the extracted parameters.

8. The method of claim **23**, further comprising:

performing an application specific action when the taps are determined to be valid user input; and

performing a second application specific action in response to one or more subsequent taps between the first device and the second device, where the second application specific action includes:

coordinating at least one of an audio task or a visual task with the second device.

9. (canceled)

10. The method of claim **23**, further comprising:

performing an application specific action when the taps are determined to be valid user input; and

performing a second application specific action in response to one or more subsequent taps between the first device and the second device, where the second application specific action includes at least one of:

receiving personal contact information from the second device,

conducting a commercial transaction with the second device, or

receiving a video clip, audio clip, image, or text from the second device.

11. The method of claim **23**, further comprising:

performing an application specific action when the taps are determined to be valid user input; and

performing a second application specific action in response to subsequent taps between the first device and the second device, where performing the second application specific action includes at least one of:

terminating a communication session that has been established based on taps between the first device and the second device; or

causing the first device to terminate a communication session that has been established prior to taps between the first device and a third device.

12. A device comprising:

a sensor; and

a processor configured to:

receive a signal from the sensor;

detect taps based on the signal;

extract parameters that are associated with the detected taps;

send a request to a second device to verify if the extracted parameters match parameters that are obtained from taps by the second device;

determine if the detected taps are valid user input based on a response from the second device, the response including parameters that are obtained from taps by the second device; and

interact with the second device over a communication channel when the taps are valid user input.

13. The device of claim **12**, where the parameters include at least one of:

time between consecutive taps; or

time of occurrence of a tap.

14. The device of claim **12**, where the sensor includes at least one of:

an accelerometer; or

an electric field sensor.

15. The device of claim **12**, where the second device includes at least one of:

a cell phone with a display or a speaker;

a headset; or

a laptop.

16. The device of claim **12**, where the device comprises:

a cell phone.

17. The device of claim **12**, where the communication channel includes:

a Bluetooth communication channel.

18. The device of claim **12**, where the request includes the extracted parameters, and the response includes information that indicates whether the extracted parameters match the parameters that are obtained from taps by the second device.

19. (canceled)

20. The device of claim **12**, where the processor is further configured to at least one of:

cause the second device to terminate a communication session that has been established prior to detected taps between the second device and a third device; or

terminate a communication session that has been established based on detected taps between the first device and the second device.

21. A method comprising:

receiving, at a first device, a signal from a sensor coupled to the first device;

determining, by the first device, whether the first device is tapped against a second device based the signal;

obtaining, by the first device, when the first device is determined to be tapped against the second device, parameters regarding taps that are detected based on the signal, where obtaining parameters includes:

obtaining locations of the taps on a surface of the first device,

determining time between consecutive taps, or

determining time of occurrence of at least one of the taps;

sending, by the first device, a first message from the first device to the second device, the message including the parameters;

receiving, at the first device, a second message from the second device;

determining, by the first device, whether the taps are valid user input based on the second message from the second device; and

terminating, by the first device, a communication link between the second device and the first device when the taps are valid user input.

22. The method of claim **21**, further comprising:

determining whether the first device is tapped against a third device;

receiving a message from the third device when the first device is tapped against the third device;

determining whether the taps are valid user input based on the message from the third device; and

establishing a communication link between the third device and the first device when the taps are valid user input.

23. A method comprising:

receiving, at a first device, a signal from a sensor associated with the first device;

detecting, by the first device, taps based on the signal;

extracting, by the first device, parameters that are associated with the detected taps;

sending, by the first device, a request to a second device to verify if the extracted parameters match parameters that are obtained from taps by the second device;

determining, by the first device, if the detected taps are valid user input based on a response from the second device, the response including parameters that are obtained from taps by the second device; and

interacting, using the first device, with the second device over a communication channel, when the taps are determined to be valid user input.

24. The method of claim **23**, further comprising:

performing an application specific action when the taps are valid user input, where the performing the application specific action includes one of:

sending an audio signal to the second device for output by a speaker, or

sending a video signal to the second device for display.

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