US010248298B2

(12) **United States Patent**
Birnbaum et al.

(10) **Patent No.: US 10,248,298 B2**
(45) **Date of Patent: *Apr. 2, 2019**

(54) **HAPTICALLY ENHANCED INTERACTIVITY WITH INTERACTIVE CONTENT**

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(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

This patent is subject to a terminal disclaimer.

(21) Appl. No.: **16/101,608**

(22) Filed: **Aug. 13, 2018**

(65) **Prior Publication Data**

US 2018/0356963 A1 Dec. 13, 2018

Related U.S. Application Data

(63) Continuation of application No. 15/639,394, filed on Jun. 30, 2017, now Pat. No. 10,073,598, which is a (Continued)

(51) **Int. Cl.**
G06F 3/00 (2006.01)
G06F 3/048 (2013.01)
(Continued)

(52) **U.S. Cl.**
CPC ***G06F 3/04842*** (2013.01); ***A63F 13/28*** (2014.09); ***G06F 3/016*** (2013.01);
(Continued)

(58) **Field of Classification Search**
None
See application file for complete search history.

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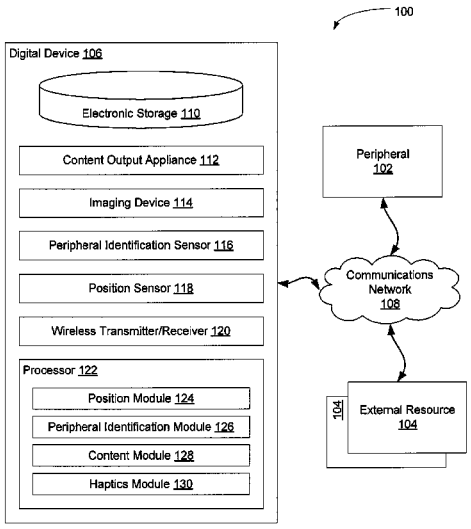
(57) **ABSTRACT**

Interactive content may be presented to a user that is manipulating a peripheral. One or more state parameters that are related to the position of the peripheral may be determined. The peripheral may be identified from a plurality of possible peripherals. The interactive content may be adjusted based at least in part on the one or more position parameters and/or the identification of the peripheral. Haptic feedback to be provided to the user may be determined based at least in part on the one or more position parameters and/or the identification of the peripheral.

24 Claims, 4 Drawing Sheets



Related U.S. Application Data

continuation of application No. 14/293,722, filed on Jun. 2, 2014, now Pat. No. 9,727,217, which is a continuation of application No. 13/712,472, filed on Dec. 12, 2012, now Pat. No. 8,745,284, which is a continuation of application No. 12/895,161, filed on Sep. 30, 2010, now Pat. No. 8,352,643.

(51) **Int. Cl.**

G06F 3/0484	(2013.01)
G06F 3/0483	(2013.01)
A63F 13/28	(2014.01)
G06F 3/01	(2006.01)
G06F 3/0488	(2013.01)
H04B 1/3827	(2015.01)
G06F 3/0346	(2013.01)

(52) **U.S. Cl.**

CPC ***G06F 3/0346*** (2013.01); ***G06F 3/0483*** (2013.01); ***G06F 3/0488*** (2013.01); ***G06F 3/04847*** (2013.01); ***H04B 1/3827*** (2013.01); *G06F 3/04883* (2013.01); *G06F 2203/013* (2013.01)

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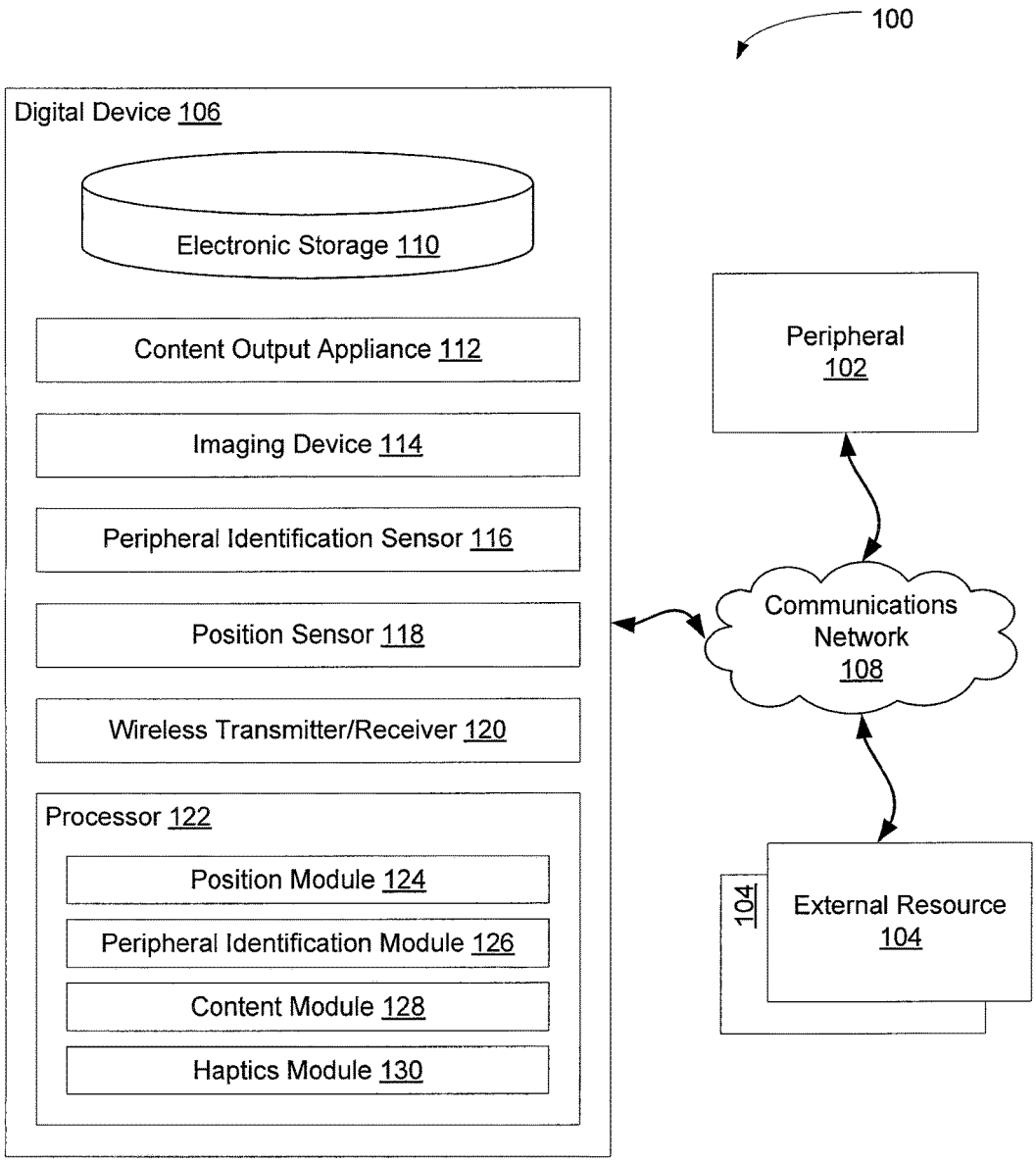
100
Digital Device 106
Electronic Storage 110
Content Output Appliance 112
Imaging Device 114
Peripheral Identification Sensor 116
Position Sensor 118
Wireless Transmitter/Receiver 120
Processor 122
Position Module 124
Peripheral Identification Module 126
Content Module 128
Haptics Module 130
Peripheral 102
Communications Network 108
External Resource 104
104

FIG. 1

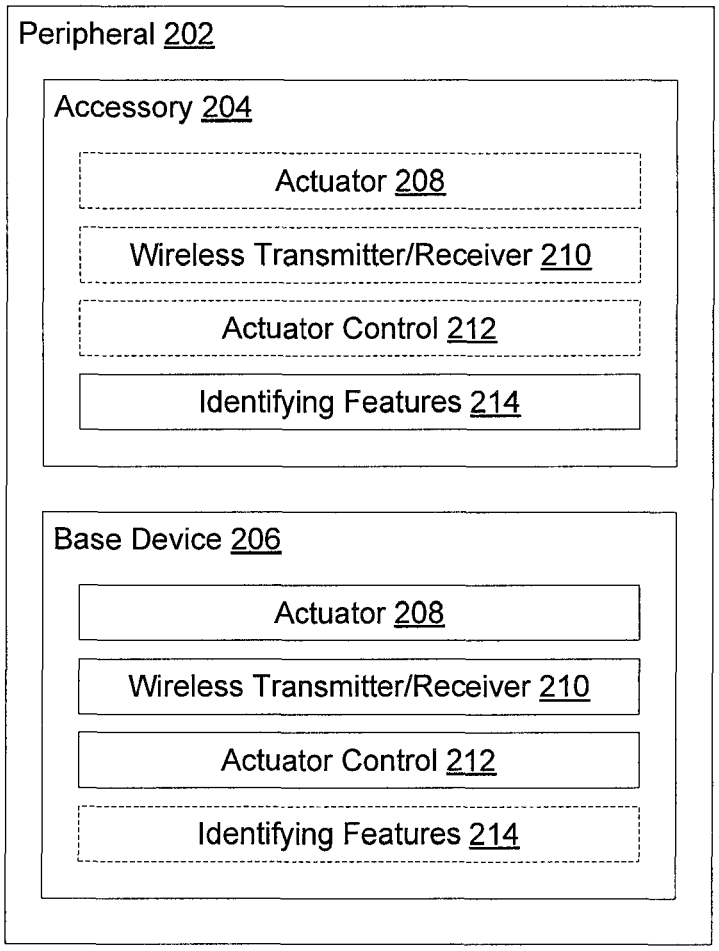
Peripheral 202
Accessory 204
Actuator 208
Wireless Transmitter/Receiver 210
Actuator Control 212
Identifying Features 214
Base Device 206
Actuator 208
Wireless Transmitter/Receiver 210
Actuator Control 212
Identifying Features 214

FIG. 2

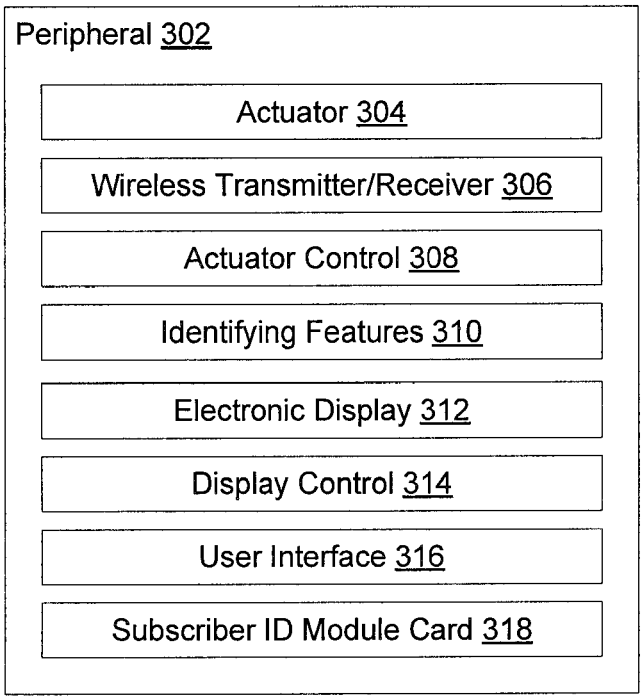
Peripheral 302
Actuator 304
Wireless Transmitter/Receiver 306
Actuator Control 308
Identifying Features 310
Electronic Display 312
Display Control 314
User Interface 316
Subscriber ID Module Card 318

FIG. 3

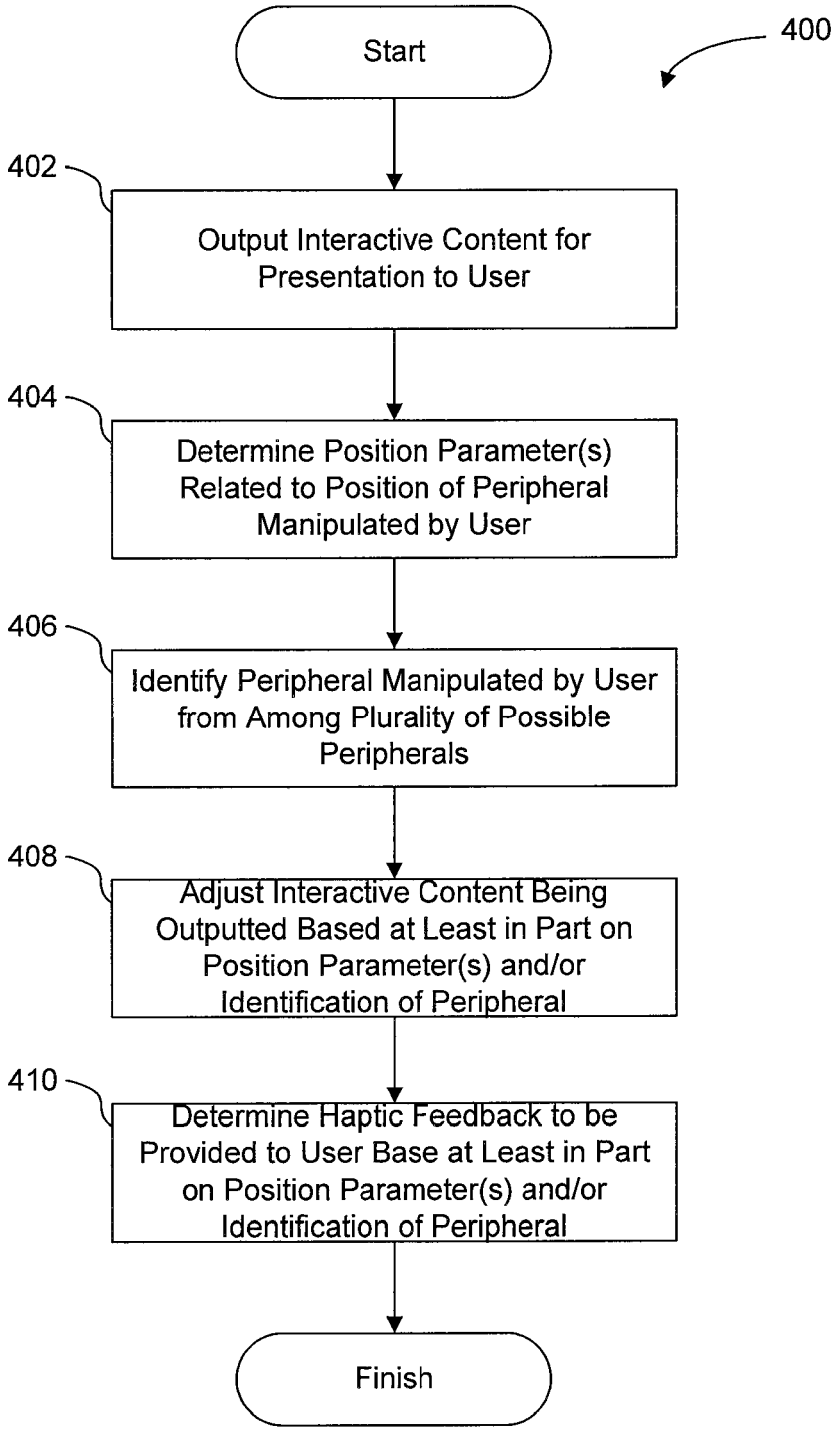
400
Start
402
Output Interactive Content for Presentation to User
404
Determine Position Parameter(s) Related to Position of Peripheral Manipulated by User
406
Identify Peripheral Manipulated by User from Among Plurality of Possible Peripherals
408
Adjust Interactive Content Being Outputted Based at Least in Part on Position Parameter(s) and/or Identification of Peripheral
410
Determine Haptic Feedback to be Provided to User Base at Least in Part on Position Parameter(s) and/or Identification of Peripheral
Finish

FIG. 4

HAPTICALLY ENHANCED INTERACTIVITY WITH INTERACTIVE CONTENT

CROSS-REFERENCES TO RELATED APPLICATIONS

This application is a continuation application of U.S. patent application Ser. No. 15/639,394, filed Jun. 30, 2017, which is a continuation application of U.S. patent application Ser. No. 14/293,722, filed Jun. 2, 2014, and issued as U.S. Pat. No. 9,727,217 on Aug. 8, 2017, which is a continuation application of U.S. patent application Ser. No. 13/712,472, filed Dec. 12, 2012, and issued as U.S. Pat. No. 8,745,284 on Jun. 30, 2014, which is a continuation application of U.S. patent application Ser. No. 12/895,161, filed Sep. 30, 2010 and issued as U.S. Pat. No. 8,352,643 on Jan. 8, 2013, the entirety of each of which is hereby incorporated by reference herein.

FIELD OF THE INVENTION

The invention relates to haptically enhanced interactivity with interactive content being conveyed to a user by a content output appliance, wherein the content output appliance is under control of one or more processors that control the output of the interactive content based on one or more position parameters of a peripheral being manipulated by the user.

BACKGROUND OF THE INVENTION

Users may interact with virtual objects within a virtual environment in a number of manners. In some cases, users may manipulate a physical object in the real world in order to interact with a virtual object. Such interactions may involve augmented reality technology, which may integrate 2D and/or 3D virtual objects into live video that is digitally processed and "augmented" with the 2D and/or 3D virtual objects. In other words, this digital processing can mix real and virtual worlds together, in real and/or near-real time. Conventionally, visual and/or audio feedback may provide a sense of interaction with virtual objects to users. For example, a virtual object may be presented to a user on a display where the virtual object can be seen as moving with or without accompanying sound effects. In existing systems, however, no physical sense of interaction with virtual objects is provided to users.

BRIEF SUMMARY OF THE INVENTION

One aspect of the invention relates to a system configured to present interactive content to a user that is manipulating a peripheral. The system may include a content output appliance configured to output interactive content to the user and a processor configured to execute computer program modules. The computer program modules may include a position module, a peripheral identification module, a content module, and a haptics module. The position module may be configured to determine one or more position parameters that are related to the position of the peripheral. The peripheral identification module may be configured to identify the peripheral from a plurality of possible peripherals. The content module may be configured to adjust the interactive content output by the content output appliance based on the one or more position parameters. The haptics module may be configured to determine haptic feedback to be provided to the user. The haptics module may be configured to determine

the haptic feedback based on the identification of the peripheral and the one or more position parameters.

Another aspect of the invention relates to a peripheral configured to enhance the interactivity of interactive content being conveyed to a user by a content output appliance. The content output appliance may be under control of one or more processors that control the output of the interactive content based on one or more position parameters of the peripheral. The peripheral may include an actuator, a wireless receiver, an actuator control, and one or more identifying features. The actuator may be configured to generate haptic feedback for the user. The wireless receiver may be configured to receive information from the one or more processors defining one or more feedback parameters of the haptic feedback to be generated by the actuator. The actuator control may be configured to control the actuator to generate haptic feedback for the user in accordance with the received information defining the one or more feedback parameters. The one or more identifying features may identify the peripheral to the one or more processors from other peripherals that are usable with the interactive content such that the one or more feedback parameters communicated from the one or more processors to the peripheral are dependent on the identifying features of the peripheral.

These and other objects, features, and characteristics of the present invention, as well as the methods of operation and functions of the related elements of structure and the combination of parts and economies of manufacture, will become more apparent upon consideration of the following description and the appended claims with reference to the accompanying drawings, all of which form a part of this specification, wherein like reference numerals designate corresponding parts in the various figures. It is to be expressly understood, however, that the drawings are for the purpose of illustration and description only and are not intended as a definition of the limits of the invention. As used in the specification and in the claims, the singular form of "a", "an", and "the" include plural referents unless the context clearly dictates otherwise.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** illustrates a system configured to present interactive content to one or more users manipulating one or more peripherals, in accordance with one or more implementations of the invention.

FIG. **2** illustrates a peripheral configured to enhance the interactivity of interactive content being conveyed to a user by a content output appliance, in accordance with one or more implementations of the invention.

FIG. **3** illustrates another peripheral configured to enhance the interactivity of interactive content being conveyed to a user by a content output appliance, in accordance with one or more implementations of the invention.

FIG. **4** illustrates a method for interacting with interactive content being conveyed to a user by a content output appliance, in accordance with one or more implementations of the invention.

DETAILED DESCRIPTION OF THE INVENTION

FIG. **1** illustrates a system **100** configured to present interactive content to one or more users manipulating one or more peripherals, in accordance with one or more implementations of the invention. Interactive content may include a representation of the real world, a representation of a

virtual environment, a representation of a user, a representation of a real-world object, a virtual object, real and/or artificial sounds, other content, and/or combinations thereof. Exemplary implementations provide haptic technologies, or "haptics", to enhance interactivity with interactive content. Haptics may include tactile and/or kinesthetic (force) feedback technology that takes advantage of a user's sense of touch by applying forces, vibrations, motions, and/or other touch feedback to the user. This may provide a more compelling and complete user experience while interacting with interactive content.

In some implementations, the system **100** may include at least one peripheral **102**, one or more external resources **104**, at least one digital device **106**, and/or other components. Components of the system **100**, the peripheral **102**, the external resources **104**, and/or the digital device **106** may be operatively linked via one or more electronic communication links. For example, such electronic communication links may be established, at least in part, via a communications network **108**, which may include the Internet and/or other networks. It will be appreciated that this is not intended to be limiting, and that the scope of this disclosure includes implementations in which the peripheral **102**, the external resources **104**, and/or the digital device **106** are operatively linked via some other communication media.

The peripheral **102** may include a physical object, a physical device, and/or a combination thereof that can be manipulated by a user to interact with interactive content. Such manipulation of the peripheral **102** may include translating, rotating, deforming, and/or otherwise moving the peripheral **102**. Examples of physical objects that may constitute the peripheral **102** may include consumer products such as toys, beverage containers, packaging, magazines, figurines, cards (e.g., sports cards, game cards, gift cards, and/or other cards), books, sporting/fitness equipment, collectible items, and/or other consumer products; a body part of a user (e.g., hand, head, face, torso, and/or other body part); a piece of paper and/or cardstock bearing graphics, which may or may not have been printed by a user; and/or other physical objects. Physical devices that may be included in the peripheral **102** may include, for example, a mobile telephone, a digital music player, a personal digital assistant, a Smartphone, a wrist watch, an e-book reader, a laptop computer, a tablet computer, a remote control, a wearable computer (interactive clothing/accessories), a computing/interactive digital media device implanted in or on the user's body, and/or other physical devices. Generally, however, anything manipulatable or able to be interacted with by a user may constitute the peripheral **102**, in accordance with exemplary implementations. Exemplary peripherals that may constitute the peripheral **102**, in accordance with one or more implementations of the invention, are described further in connection with FIGS. **2** and **3**.

The external resources **104** may include sources of information, hosts and/or providers of interactive content outside of the system **100**, external entities participating with the system **100**, and/or other resources. In some implementations, some or all of the functionality attributed herein to the external resources **104** may be provided by resources included in the system **100**.

The digital device **106** may be configured to present interactive content to users, and to facilitate interaction with the interactive content to users manipulating the peripheral **102**. As depicted in FIG. **1**, the digital device **106** may include one or more of electronic storage **110**, a content output appliance **112**, an imaging device **114**, a peripheral identification sensor **116**, a position sensor **118**, a wireless transmitter/receiver **120**, at least one processor **122**, and/or other components. By way of non-limiting example, the digital device **106** may include one or more of a desktop computer, a mobile telephone, a digital music player, a personal digital assistant, a Smartphone, a wrist watch, an e-book reader, a laptop computer, a tablet computer, a remote control, a wearable computer (interactive clothing/accessories), a computing/interactive digital media device implanted in or on the user's body, and/or other computing platforms.

It will be appreciated that one or more of the constituent components of the digital device **106** may be combined into a single component with functionalities attributed herein to one or more constituent components of the digital device **106**. It will be appreciated that, while the constituent components of the digital device **106** are depicted in FIG. **1** as being collocated, this may not be the case. In some implementations, one or more components of the digital device **106** may be physically located apart and separate from other components of the digital device **106**. In such implementations, separate components of the digital device **106** may be communicatively coupled (by wire or wirelessly) to one or more other components of the digital device **106**. Communicative coupling may be provided by the communications network **108**.

The electronic storage **110** may comprise electronic storage media that electronically stores information. The electronic storage media of the electronic storage **110** may include one or both of system storage that is provided integrally (i.e., substantially non-removable) with the digital device **106** and/or removable storage that is removably connectable to the digital device **106** via, for example, a port (e.g., a USB port, a firewire port, etc.) or a drive (e.g., a disk drive, etc.). The electronic storage **110** may include one or more of optically readable storage media (e.g., optical disks, etc.), magnetically readable storage media (e.g., magnetic tape, magnetic hard drive, floppy drive, etc.), electrical charge-based storage media (e.g., EEPROM, RAM, etc.), solid-state storage media (e.g., flash drive, etc.), and/or other electronically readable storage media. The electronic storage **110** may store software algorithms, information determined by processor **122**, information received from peripheral **102**, information received from the external resources **104**, and/or other information that enables the digital device **106** to function as described herein.

The content output appliance **112** may be configured to output interactive content to the user. Interactive content may be outputted visually, audibly, and/or haptically. Interactive content may be provided to the content output appliance **112** for outputting from the electronic storage **110**, the processor **122** and/or modules thereof, the external resources **104**, and/or other sources. According to exemplary implementations, the content output appliance **112** may include an electronic display (e.g., monitor or screen), an electronic sound transducer (e.g., speaker), and/or other content output appliances. The content output appliance **112** may output interactive content that is haptically perceivable. For example, an electronic sound transducer included in content output appliance **112** may be configured in such a way as to output ranges of energy and at locations so to be perceived by the user's haptic perceptual system. This haptic output may be independent of, coordinated with, or in place of additional dedicated haptic output devices such as actuators.

The imaging device **114** may be configured to capture information related to a visual representation of the surroundings of the digital device **106** or components thereof. The surroundings may include a user, a peripheral **102**, the

physical environment of the user, and/or other visual representations. The visual representation may include one or more still images, video, and/or other visual representations. Information captured by the imaging device **114** may be provided to the content output appliance **112**, the processor **122** and/or modules thereof, and/or other components of the system **100**. The imaging device **114** may include, by way of non-limiting example, a digital camera, a web-camera, an analog camera, a 3D camera, a stereo camera, and/or other imaging devices.

The peripheral identification sensor **116** may be configured to generate an output signal that conveys information that identifies the peripheral **102**. In some implementations, the peripheral identification sensor **116** may be configured to identify the peripheral **102** from a plurality of other peripherals. The peripheral identification sensor **116** may identify the peripheral **102** visually in some implementations. In such implementations, the peripheral identification sensor **116** may be the imaging device **114**. According to some implementations, the peripheral identification sensor **116** may identify the peripheral **102** by remote sensing. Remote sensing of the identity of the peripheral **102** may include RFID, image recognition, optical code identification and/or translation, GPS or other location sensor, wireless connection signal strength, network address, wireless protocols (e.g., Bluetooth), wired connection and/or other remote sensing technologies. The peripheral identification sensor **116** may provide an identification of the peripheral **102**, such as by an output signal, to the processor **122** and/or modules thereof, and/or other components of the system **100**.

The position sensor **118** may be configured to sense a position of the peripheral **102** in the real world. The position sensor **118** may sense the position of the peripheral **102** visually, in some implementations. In such implementations, the position sensor **118** may be the imaging device **114**. In accordance with some implementations, the position sensor **118** may sense the position of the peripheral **102** by remote sensing. Remote sensing of the position of the peripheral **102** may include triangualation based on RFID, WiFi, or other wireless communication protocol, capacitive field sensing, optical or other types of motion tracking, access to data from device-embedded sensors such as magnetometer, accelerometer/gyroscope, and/or other remote sensing techniques. The position sensor **118** may be configured to generate an output signal that conveys information related to the position of the peripheral **102**. Such an output signal may be provided to the processor **122** and/or modules thereof, and/or other components of the system **100**. In some implementations, the position sensor **118** may include one or more sensors carried by peripheral **102**. For example, the position sensor **118** may include one or more of an accelerometer, a gyroscope, a digital compass, and/or other sensors configured to generate output signals conveying information related to the position and/or motion of peripheral **102**.

The wireless transmitter/receiver **120** may be configured to wirelessly transmit information to and/or wirelessly receive information from one or more components of the system **100**. As such, the wireless transmitter/receiver **120** may include a wireless transmitter, a wireless receiver, and/or a combined wireless transmitter and receiver. Information transmitted or received by the wireless transmitter/receiver **120** may be related to haptic feedback to be delivered to the user.

The processor **122** may be configured to provide information processing capabilities in the digital device **106**. As such, the processor **122** may include one or more of a digital processor, an analog processor, a digital circuit designed to process information, an analog circuit designed to process information, a state machine, and/or other mechanisms for electronically processing information. Although the processor **122** is shown in FIG. **1** as a single entity, this is for illustrative purposes only. In some implementations, processor **122** may include a plurality of processing units. These processing units may be physically located within the same device, or the processor **122** may represent processing functionality of a plurality of devices operating in coordination. For example, processor **122** may include a first processor included in digital device **106** and a second processor included in peripheral **102**. The first processor and the second processor may be in communication with each other, and may cooperate to provide the functionality attributed herein to processor **122**.

As is shown in FIG. **1**, the processor **122** may be configured to execute one or more computer program modules. The one or more computer program modules may include one or more of a position module **124**, a peripheral identification module **126**, a content module **128**, a haptics module **130**, and/or other modules. The processor **122** may be configured to execute modules **124**, **126**, **128**, and/or **130** by software; hardware; firmware; some combination of software, hardware, and/or firmware; and/or other mechanisms for configuring processing capabilities on the processor **122**.

It should be appreciated that although modules **124**, **126**, **128**, and **130** are illustrated in FIG. **1** as being co-located within a single processing unit, in implementations in which the processor **122** includes multiple processing units, one or more of modules **124**, **126**, **128**, and/or **130** may be located remotely from the other modules. The description of the functionality provided by the different modules **124**, **126**, **128**, and/or **130** described below is for illustrative purposes, and is not intended to be limiting, as any of modules **124**, **126**, **128**, and/or **130** may provide more or less functionality than is described. For example, one or more of modules **124**, **126**, **128**, and/or **130** may be eliminated, and some or all of its functionality may be provided by other ones of modules **124**, **126**, **128**, and/or **130**. As another example, processor **122** may be configured to execute one or more additional modules that may perform some or all of the functionality attributed below to one of modules **124**, **126**, **128**, and/or **130**.

The position module **124** may be configured to determine one or more position parameters that are related to the position of one or more peripherals (e.g., the peripheral **102**). Position parameters may include information related to the position of a peripheral relative to a user, the digital device **106**, and/or other point of reference; the orientation of the peripheral; the size of the peripheral; and/or other information. In some implementations, the position module may be configured to determine the one or more position parameters based, at least in part, on an output signal of the position sensor **118**. Information from the imaging device **114** may be utilized to determine the one or more position parameters, in accordance with some implementations.

The peripheral identification module **126** may be configured to identify a peripheral (e.g., the peripheral **102**) from a plurality of possible peripherals. Possible peripherals may include various physical objects and/or physical devices proximate to a user. In some implementations, the peripheral identification module **126** may be configured to identify the peripheral based on the output signal of the peripheral identification sensor **116**. The peripheral identification module **126** may be configured to identify the peripheral based on the appearance and/or a visual aspect of the peripheral. For example, in some implementations, the peripheral iden-

tification module **126** may be configured to identify the peripheral based on graphics borne by the peripheral. According to some implementations, the peripheral identification module **126** may be configured to identify the peripheral by identifying a type of peripheral from among a plurality of peripheral types. Exemplary peripheral types may include a type of physical object, a type of physical device, and/or other peripheral types.

The content module **128** may be configured to adjust the interactive content outputted by the content output appliance **112**. Adjustment of the interactive content may be based, at least in part, on the one or more position parameters as determined by the position module **124**, on the identity of the peripheral and/or on the type of peripheral as determined by the peripheral identification module **126**, and/or other factors. Adjusting the interactive content outputted by the content output appliance **112** may include adjusting the appearance, orientation, size, position, subject matter, sound, sound level, and/or other aspects of the interactive content.

The haptics module **130** may be configured to determine haptic feedback to be provided to the user. Haptic feedback may be experienced by the user via the peripheral **102**, as described further in connection with FIGS. **2** and **3**. Haptic feedback may include tactile feedback that takes advantage of a user's sense of touch. Haptic feedback may include forces, vibrations, motions, and/or other tactile feedback applied by the peripheral **102** to the user. The haptics module **130** may be configured to determine the haptic feedback based, at least in part, on the identification of the peripheral **102** as determined by the peripheral identification module **126**. The haptics module **130** may be configured to determine the haptic feedback based, at least in part, on the one or more position parameters as determined by the position module **124**. The haptics module **130** may be configured such that the haptic feedback is further based, at least in part, on the interactive content being output by the content output appliance **112**. Information related to the haptic feedback to be provided to the user may be transmitted by the wireless transmitter/receiver **120**.

FIG. **2** illustrates a peripheral **202**, in accordance with one or more implementations of the invention. The peripheral **202** may be configured to enhance the interactivity of interactive content being conveyed to a user by the content output appliance **112**. The peripheral **202** may constitute the peripheral **102** depicted in FIG. **1**, according to some implementations. As depicted in FIG. **2**, the peripheral **202** may include an accessory **204**, a base device **206**, and/or other components. Although the accessory **204** and the base device **206** are depicted in FIG. **2** as including certain components, this is not intended to be limiting as the accessory **204** and/or the base device **206** may include one or more of an actuator **208**, a wireless transmitter/receiver **210**, an actuator control **212**, one or more identifying features **214**, and/or other components. In some implementations, for example, the accessory **204** and/or the base device **206** may include (not depicted in FIG. **2**) one or more of a battery, an audio playback device, an accelerometer, a motion detector, buttons, and/or other components.

The actuator **208** may be configured to generate haptic feedback for the user. Haptic feedback may include forces, vibrations, motions, a haptic component of a multimodal signal, and/or other tactile feedback applied by the peripheral **202** to the user. The actuator **208** may include a mechanical device configured to cause one or more motions of the peripheral **202**. The actuator **208** may convert energy (e.g., electric, pneumatic, hydraulic, and/or other energy) in to mechanical energy resulting in one or motions of the peripheral **202**. In some implementations, the actuator **208** may include an electric motor with an unbalanced mass on its driveshaft such that rotation of the driveshaft generates vibrations. The actuator **208** may be carried by the accessory **204** and/or the base device **206** in accordance with exemplary implementations.

The wireless transmitter/receiver **210** may be configured to wirelessly transmit information to and/or wirelessly receive information from one or more components of the system **100**. As such, the wireless transmitter/receiver **210** may include a wireless transmitter, a wireless receiver, and/or a combined wireless transmitter and receiver. Information transmitted or received by the wireless transmitter/receiver **210** may be related to haptic feedback to be delivered to the user. For example, the wireless transmitter/receiver **210** may be configured to receive information from the one or more processors (e.g., the processor **122**) defining one or more feedback parameters of the haptic feedback to be generated by the actuator **208**. Feedback parameters may include the type of haptic feedback, the duration of haptic feedback, the intensity or magnitude of haptic feedback, frequency of periodic haptic signal, harmonic content of haptic signal, pattern of haptic pulses or aspects of haptic signal, static and/or changing deformation features, and/or other aspects of haptic feedback.

The actuator control **212** may be configured to control the actuator **208**. The actuator control **212** may control the actuator **208** so as to cause the actuator **208** to generate haptic feedback for the user. The control of the actuator **208** by the actuator control **212** may be in accordance with information received from one or more processors (e.g., the processor **122**) defining one or more feedback parameters. The actuator control **212** may be carried by the accessory **204** and/or the base device **206** in accordance with exemplary implementations.

The identifying features **214** may be configured to identify the peripheral **202** and/or the accessory **204** to the one or more processors (e.g., the processor **122**). The identifying features **214** may identify the peripheral **202** and/or the accessory **204** from other peripherals and/or accessories that are usable with the interactive content. The one or more feedback parameters communicated from the one or more processors (e.g., the processor **122**) to the peripheral **202** may be dependent on the identifying features of the peripheral **202** and/or the accessory **204**. The identifying features may include graphics, markings, colors, and/or other visual traits.

The accessory **204** may be a physical object and/or a physical device configured to be associated with the base device **206**. Association of the accessory **204** with the base device **206** may include physical coupling and/or other association. Physical coupling between the accessory **204** and the base device **206** may include removably attaching the accessory **204** to the base device **206**, permanently attaching the accessory **204** to the base device **206**, interchangeably coupling the accessory **204** and the base device **206**, and/or other physical coupling. A plurality of accessories, such as the accessory **204**, may be interchanged in the base device **206**. The particular accessory associated with the base device **206** may affect the interactive content provided to the user via the content output appliance **112**. The accessory **204** may bear certain graphics, which may constitute identifying features utilized by one or more modules of the processor **122**.

According to some implementations, the accessory **204** may include a card-like or other paper-like physical form

factor. Examples of such form factors may include collectible cards (e.g., sports cards and/or gaming cards), greeting cards (e.g., birthday cards), product brochures and/or other promotional materials, maps and/or other guides, books, magazines, newspapers, and/or other card-like or other paper-like form factors. The base device **206** may be configured to receive the accessory **204** such that the accessory **204** is removably coupled with the base device **206**. As such, a plurality of accessories similar to the accessory **204** may be interchangeable in the base device **206**. By way of non-limiting example, the base device **206** may include a slot in which an accessory (e.g., the accessory **204**) having a card-like form factor may be inserted such that a portion of the accessory is visible. The base device **206** may be configured to provide haptic feedback to the user when the accessory **204** is coupled therewith. The haptic feedback provided to the user may be dependent on the accessory **204**, where different accessories may result in different haptic feedback.

In some implementations, the accessory **204** may provide haptic feedback to the user without the base device **206**. In such implementations, the base device **206** may be omitted from the system **100**, or be used for other purposes. For example, the base device **206** may be used to store one or more accessories, charge one or more accessories, select one or more accessories, and/or otherwise complement the use of the accessory **204**.

According to some implementations, in which the accessory **204** has a book-like form factor, one or more individual pages may include embedded information that triggers presentation of interactive content by the content output appliance **112** of the digital device **106**. In such implementations, the book binding may constitute the digital device **106**, while the particular page to which the book-like form factor is opened may constitute the accessory **204**.

FIG. **3** illustrates a peripheral **302**, in accordance with one or more implementations of the invention. The peripheral **302** may be configured to enhance the interactivity of interactive content being conveyed to a user by the content output appliance **112**. The peripheral **302** may constitute the peripheral **102** depicted in FIG. **1**, according to some implementations. As depicted in FIG. **2**, the peripheral **302** may include one or more of an actuator **304**, a wireless transmitter/receiver **306**, an actuator control **308**, one or more identifying features **310**, an electronic display **312**, a display control **314**, a user interface **316**, and/or other components. In some implementations, for example, the peripheral **302** may include (not depicted in FIG. **3**) one or more of a battery, an audio playback device, an accelerometer, a motion detector, buttons, and/or other components. The actuator **304**, the wireless transmitter/receiver **306**, the actuator control **308**, and/or the identifying features **310** may be similar, respectively, to the actuator **208**, the wireless transmitter/receiver **210**, the actuator control **212**, and/or the identifying features **214** described in connection with FIG. **2**. In some implementations, the identifying features **310** may include a subscriber identity module card **318**, which may be removably coupled with the peripheral **302**.

The electronic display **312** may be configured to display content (e.g., images, video, text, and/or other content) to the user. Content displayed by the electronic display **312** may include identifying features that can be used by one or more modules of the content output appliance **112**. Content displayed by the electronic display **312** may include interactive content that is the same, similar to, and/or different than interactive content presented by the content output appliance **112** of the digital device **106**. The electronic display **312** may be integrated with the peripheral **302** as a single device. The electronic display **312** may be separate from the peripheral **302** and communicatively coupled with the peripheral **302**. According to some implementations, the electronic display **312** may include a touch screen configured to receive information from the user.

The display control **314** may be configured to control the electronic display **312**. The display control **314** may control the electronic display **312** to present interactive content to the user that corresponds to the interactive content being conveyed to the user by the content output appliance **112**. The display control **314** may control the electronic display **312** to present identifying features.

The user interface **316** may be configured to receive information from the user and/or provide information to the user. As such, the user interface **316** may include hardware and/or software to facilitate receiving information from the user and/or providing information to the user. Exemplary hardware may include one or more of buttons, dials, touch pads, and/or other hardware. In accordance with some implementations, some or all of the user interface **316** may be presented to the user via the electronic display **312**. In implementations where the electronic display **312** includes a touch screen, the user may provide information to the user interface **316** by manipulating the touch screen.

In some implementations, the user interface **316** may be configured to present user configurable settings to the user. The user interface **316** may be configured to receive selections from the user of values for the user configurable settings. One or more user configurable settings may impact the haptic feedback that is generated by the actuator **304** of the peripheral **302**. The user configurable settings may configure one or more aspects of operation of the actuator control **308** of the peripheral **302**. The user configurable settings may be provided to one or more processors. In some implementations, the user configurable settings may be provided to the processor **122** of the digital device **106** by way of the wireless transmitter/receiver **306** of the peripheral **302**.

According to some implementations, the peripheral **302** may include a mobile telephone, a digital music player, a personal digital assistant, a Smartphone, a wrist watch, an e-book reader, a laptop computer, a tablet computer, a remote control, a wearable computer (interactive clothing/accessories), a computing/interactive digital media device implanted in or on the user's body, and/or other mobile device. The mobile device may be configured for one or more of single-player gaming, multi-player gaming, social networking, interaction with virtual and/or augmented reality environments, interactive messaging and/or other communication, confirmation of remote manipulation (e.g., telerobotics, locking/unlocking real and/or virtual locks), interactive responses based on in-story character actions and/or plot developments in text-based and/or video-based stories, and/or other mobile applications.

In implementations that involve single-player gaming and/or multi-player gaming, haptic feedback may be provided to the user via the peripheral **302** responsive to events and/or interactions within a game. For example, the actuator **304** may vibrate during an explosion taking place in the game or during certain music within the game. In implementations that involve social networking, haptic feedback may be provided to the user via the peripheral **302** responsive to events and/or interactions within the social network. In one example, the actuator **304** may vibrate when the user obtains a friend in the social network.

In implementations that involve interactive messaging and/or other communication, communications may include haptic feedback. Such communications may include virtual touch communications where the user can feel the reaction of interactive messaging elements (e.g., emoticons). Such communications may include virtual touch objects coming in contact with one another, such as for example, a virtual hand associated with the user contacting another virtual hand triggering a haptic effect via the peripheral **302**.

In implementations involving confirmation of remote manipulation, a virtual environment may be presented to the user (e.g., via the content output appliance **112** and/or the electronic display **312**), which represents a real-world environments. Robots and/or other mechanisms within the real-world environment may be controlled by the user to interact with objects in the real-world environment. Those interactions may trigger haptic feedback provided by the peripheral **302**.

In implementations involving interactive responses based on in-story character actions and/or plot developments in text-based and/or video-based stories, pre-defined character actions and/or plot developments may serve as trigger points for corresponding haptic feedback. For example, when an in-story character swings a baseball bat and hits a baseball, haptic feedback representing the impact of the ball against the bat may be provided via the peripheral **302**.

As mentioned above, the peripheral **102** may include a toy. One or more components described in connection with the peripheral **202** and/or the peripheral **302** may be included in such a toy. Examples of a toy may include an action figure, a doll, a vehicle, a weapon, and/or other toys. A representation of the toy may be included in the interactive content outputted by the content output appliance **112** and/or other device. The user may experience haptic feedback via the toy responsive to actions performed by the representation of the toy may be included in the interactive content. For example, if the toy is an action figure and the representation of the toy is shown as walking in the interactive content, the toy may provide haptic feedback that corresponds to the walking. Haptic feedback may be triggered based at least in part on manipulations of the toy by the user. For example, if the toy is a weapon, simulated use of the weapon by the user may result in haptic feedback being provided by the toy.

FIG. **4** illustrates a method **400** for interacting with interactive content being conveyed to a user by a content output appliance, in accordance with one or more implementations of the invention. The operations of the method **400** presented below are intended to be illustrative. In some implementations, the method **400** may be accomplished with one or more additional operations not described, and/or without one or more of the operations discussed. Additionally, the order in which the operations of the method **400** are illustrated in FIG. **4** and described below is not intended to be limiting.

In some implementations, the method **400** may be implemented in one or more processing devices (e.g., a digital processor, an analog processor, a digital circuit designed to process information, an analog circuit designed to process information, a state machine, and/or other mechanisms for electronically processing information). The one or more processing devices may include one or more devices executing some or all of the operations of the method **400** in response to instructions stored electronically on an electronic storage medium. The one or more processing devices may include one or more devices configured through hardware, firmware, and/or software to be specifically designed for execution of one or more of the operations of the method **400**.

At an operation **402**, interactive content may be outputted to a user. In some implementations, the interactive content may be outputted by the content output appliance **112** of the digital device **106** and/or the electronic display **312** of the peripheral **302**. The content to be outputted may be determined by the content module **128**, in some implementations.

At an operation **404**, one or more position parameters that are related to the position of a peripheral being manipulated by the user may be determined. The one or more position parameters may be determined in conjunction with the position module **124**, according to some implementations. The imaging device **114** and/or the position sensor **118** may be utilized in determining the one or more position parameters.

At an operation **406**, the peripheral being manipulated by the user may be identified from among a plurality of possible peripherals. The peripheral identification module **126** may be executed to identify the peripheral being manipulated by the user. In some implementations, the imaging device **114** and/or the peripheral identification sensor **116** may be utilized in identifying the peripheral being manipulated by the user.

At an operation **408**, the interactive content being outputted may be adjusted. This adjustment may be based at least in part on one or more of the position parameter(s) determined at the operation **404**, the identification of the peripheral being manipulated by the user at the operation **406**, and/or other factors. The content module **128** may be executed to perform the operation **408** in some implementations.

At an operation **410**, haptic feedback to be provided to the user is determined. This determination may be based at least in part on the position parameter(s) determined at the operation **404**, the identification of the peripheral being manipulated by the user at the operation **406**, and/or other factors. The haptics module **130** may be executed to perform the operation **410**, in accordance with some implementations.

Although the invention has been described in detail for the purpose of illustration based on what is currently considered to be the most practical and preferred embodiments, it is to be understood that such detail is solely for that purpose and that the invention is not limited to the disclosed embodiments, but, on the contrary, is intended to cover modifications and equivalent arrangements that are within the spirit and scope of the appended claims. For example, it is to be understood that the present invention contemplates that, to the extent possible, one or more features of any embodiment can be combined with one or more features of any other embodiment.

What is claimed is:

1. A system comprising:

a processor; and

a memory device comprising program code that is executable by the processor to cause the processor to:

display a virtual environment via an electronic display;

detect an interaction with a virtual object in the virtual environment based on a peripheral being at a particular position in free space with respect to the virtual object; and

based on detecting the interaction:

determine a first feedback parameter that depends on an identifier of the peripheral and a second feed-

back parameter that depends on the particular position of the peripheral in free space; and

transmit a haptic signal configured to cause a haptic output device to output haptic feedback in accordance with the first feedback parameter and the second feedback parameter.

2. The system of claim **1**, wherein the virtual object is a three-dimensional virtual object.

3. The system of claim **1**, wherein the virtual environment is an augmented reality environment.

4. The system of claim **1**, wherein the peripheral is a body part.

5. The system of claim **1**, wherein the peripheral is a consumer product.

6. The system of claim **1**, wherein the peripheral is an electronic device that comprises the haptic output device.

7. The system of claim **1**, wherein the peripheral comprises a mobile telephone, a digital music player, a personal digital assistant, a smartphone, an e-book reader, a laptop computer, a tablet computer, or a remote control.

8. The system of claim **1**, wherein the peripheral comprises a wearable computer.

9. A method comprising:

displaying, by a processor, a virtual environment via an electronic display;

detecting, by the processor, an interaction with a virtual object in the virtual environment based on a peripheral being at a particular position in free space with respect to the virtual object; and

based on detecting the interaction:

determining, by the processor, a first feedback parameter that depends on an identifier of the peripheral and a second feedback parameter that depends on the particular position of the peripheral in free space; and

transmitting, by the processor, a haptic signal configured to cause a haptic output device to output haptic feedback in accordance with the first feedback parameter and the second feedback parameter.

10. The method of claim **9**, wherein the virtual object is a three-dimensional virtual object.

11. The method of claim **9**, wherein the virtual environment is an augmented reality environment.

12. The method of claim **9**, wherein the peripheral is a body part.

13. The method of claim **9**, wherein the peripheral is a consumer product.

14. The method of claim **9**, wherein the peripheral is an electronic device that comprises the haptic output device.

15. The method of claim **9**, wherein the peripheral comprises a mobile telephone, a digital music player, a personal digital assistant, a smartphone, an e-book reader, a laptop computer, a tablet computer, or a remote control.

16. The method of claim **9**, wherein the peripheral comprises a wearable computer.

17. A non-transitory computer-readable medium comprising program code that is executable by a processor to cause the processor to:

display a virtual environment via an electronic display;

detect an interaction with a virtual object in the virtual environment based on a peripheral being at a particular position in free space with respect to the virtual object; and

based on detecting the interaction:

determine a first feedback parameter that depends on an identifier of the peripheral and a second feedback parameter that depends on the particular position of the peripheral in free space; and

transmit a haptic signal configured to cause a haptic output device to output haptic feedback in accordance with the first feedback parameter and the second feedback parameter.

18. The non-transitory computer-readable medium of claim **17**, wherein the virtual object is a three-dimensional virtual object.

19. The non-transitory computer-readable medium of claim **17**, wherein the virtual environment is an augmented reality environment.

20. The non-transitory computer-readable medium of claim **17**, wherein the peripheral is a body part.

21. The non-transitory computer-readable medium of claim **17**, wherein the peripheral is a consumer product.

22. The non-transitory computer-readable medium of claim **17**, wherein the peripheral is an electronic device that comprises the haptic output device.

23. The non-transitory computer-readable medium of claim **17**, wherein the peripheral comprises a mobile telephone, a digital music player, a personal digital assistant, a smartphone, an e-book reader, a laptop computer, a tablet computer, or a remote control.

24. The non-transitory computer-readable medium of claim **17**, wherein the peripheral comprises a wearable computer.

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