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WEARABLE DEVICE FOR PERFORMING CONTINUOUS BEAMFORMING ON AT LEAST ONE OBJECT, AND METHOD OF CONTROLLING THE WEARABLE DEVICE

Abstract

Disclosed are a wearable device for performing continuous beamforming on at least one object, and a method of controlling the wearable device. The wearable device includes: a plurality of microphones; a display module; at least one speaker; at least one processor. The wearable device may perform beamforming on at least one object located around a user wearing the wearable device, by using at least one microphone; output, on the basis of performing the beamforming, a notification corresponding to the at least one object through at least one of the at least one speaker or the display module; identify movement of the wearable device rotating to face an object among a plurality of objects; and highlight and output, on the basis of identifying the movement, through at least one of the at least one speaker or the display module, the notification while maintaining the beamforming on the at least one object.

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Background/Summary

[0001] This application is a continuation application, claiming priority under § 365(c), of International Application No. PCT/KR2023/016270, filed on Oct. 19, 2023, which claims priority to Korean Patent Application No. 10-2022-0144156, filed on Nov. 2, 2022, and Korean Patent Application No. 10-2022-0152241, filed on Nov. 15, 2022, with the Korean Intellectual Property Office, the disclosures of which are incorporated by reference herein in their entireties.

BACKGROUND
Field
[0002] The disclosure relates to a wearable device for performing continuous beamforming with respect to at least one object, and a method of controlling the wearable device.
Description of the Related Art
[0003] Various services and additional functions provided through an electronic device, for example, a mobile electronic device, such as AR glasses or a virtual reality providing device, have been increased. Communication service providers or electronic device manufacturers have been competitively developing electronic devices for providing various functions and differentiation from other businesses to improve effective values of such electronic device and satisfy various desires of users. Therefore, various functions provided through electronic devices have become increasingly advanced.
[0004] In a case in which software processing is performed to remove noise from a voice signal input through an array of microphones included in a wearable device (e.g., AR glasses configured to provide augmented reality), a beam may be generated from the array of microphones in a particular direction in accordance with the software processing. As such, beamforming technology is used to generate a beam using the array of a plurality of microphones to direct the beam in the desired direction from the plurality of microphones. In a case in which directivity is established in the direction of sound signals generated from a specific object through beamforming technology, the energy corresponding to sound signals input from directions outside the beam is attenuated, and sound signals from the direction of interest may be selectively acquired.
[0005] In a case in which a content is provided through the wearable device (e.g., AR glasses configured to provide augmented reality), the user receiving the content provided through the wearable device may have difficulty identifying hazards, such as an external object (e.g., a vehicle) approaching from the periphery. Even during the function or operation of recognizing sound generated by such an external object and performing beamforming with respect to the external object to amplify the sound generated by the external object and providing the amplified sound to the user, if the user turns toward the external object (e.g., shifting of gaze), the beamforming may not be maintained for the external object, and amplified sound may not be delivered to the user through the wearable device.

SUMMARY

[0006] An embodiment of the disclosure may provide a wearable device which, even in a case in which after an external object (e.g., a vehicle) is identified, a user wearing the wearable device rotates (e.g., shifting of gaze) toward the external object, may perform continuously perform beamforming with respect to the external object such that object-adapted beamforming may be performed.

[0007] An embodiment of the disclosure may provide the wearable device which, in a case in which after an external object (e.g., a vehicle) is identified, a user wearing the wearable device rotates (e.g., shifting of gaze) toward the external object, may amplify and output a notification corresponding to the external object (e.g., a sound signal generated by the external object) to facilitate identification of the hazard by the user wearing the wearable device.

[0008] An embodiment of the disclosure may provide the wearable device which may activate at least one microphone corresponding (e.g., relatively close to the external object) to the external object (e.g., a vehicle) to optimize (e.g., minimize) the current consumption of the wearable device.

[0009] An embodiment of the disclosure may provide an operation method of a wearable device, by which even in a case in which after an external object (e.g., a vehicle) is identified, a user wearing the wearable device rotates (e.g., shifting of gaze) toward the external object, beamforming may be continuously performed on the external object such that object-adapted beamforming may be performed.

[0010] An embodiment of the disclosure may provide the operation method of the wearable device by which, in a case in which after an external object (e.g., a vehicle) is identified, a user wearing the wearable device rotates (e.g., shifting of gaze) toward the external object, a notification corresponding to the external object (e.g., a sound signal generated by the external object) may be amplified and output to facilitate identification of the hazard by the user wearing the wearable device.

[0011] A wearable device according to an embodiment of the disclosure may include a plurality of microphones, a display module, at least one speaker, at least one processor, and memory storing instructions that, when executed by the at least one processor individually or collectively, cause the wearable device to perform beamforming with respect to at least one object located around a user wearing the wearable device by using at least one microphone among the plurality of microphones, output, based on performing the beamforming, a notification corresponding to the at least one object through at least one of the at least one speaker or the display module, identify movement of the user (or wearable device worn by the user) in which the wearable device is rotating to face an object among a plurality of objects including the at least one object, and highlight and output, based on identifying the movement, the notification corresponding to the at least one object through at least one of the at least one speaker or the display module while maintaining the beamforming with respect to the at least one object.

[0012] An operation method of a wearable device according to an embodiment of the disclosure may include an operation of performing beamforming with respect to at least one object located around a user wearing the wearable device by using at least one microphone among a plurality of microphones, an operation of outputting, based on performing the beamforming, a notification corresponding to the at least one object through the at least one speaker of the wearable device and/or the display module of the wearable device, an operation of identifying movement of the user (or wearable device being worn by the user) in which the wearable device is rotating to face an object among a plurality of objects including the at least one object, and an operation of highlighting and outputting, based on identifying the movement, the notification corresponding to the at least one object through at least one of the at least one speaker or the display module while maintaining the beamforming with respect to the at least one object.

[0013] An embodiment of the disclosure may provide a wearable device which, even in a case in which after an external object (e.g., a vehicle) is identified, a user wearing the wearable device

rotates (e.g., shifting of gaze) toward the external object, may continuously perform beamforming with respect to the external object such that object-adapted beamforming may be performed.
[0014] An embodiment of the disclosure may provide the wearable device which, in a case in which after an external object (e.g., a vehicle) is identified, a user wearing the wearable device rotates (e.g., shifting of gaze) toward the external object, may amplify and output a notification corresponding to the external object (e.g., a sound signal generated by the external object) to facilitate identification of the hazard by the user wearing the wearable device.
[0015] An embodiment of the disclosure may provide the wearable device which may activate at least one microphone corresponding (e.g., relatively close to the external object) to the external object (e.g., a vehicle) to optimize (e.g., minimize) the current consumption of the wearable device.
[0016] The effects according to various embodiments of the document are not limited to the effects described herein, and it is obvious to those skilled in the art that various effects are inherent in the document.

Description

BRIEF DESCRIPTION OF THE DRAWINGS
[0017] FIG. **1** is a block view illustrating an electronic device in a network environment according to various embodiments of the disclosure.
[0018] FIG. **2**A is a perspective view illustrating a wearable device (e.g., an electronic device) according to an embodiment of the disclosure.
[0019] FIG. **2**B is a perspective view illustrating an inner configuration of a wearable device (e.g., an electronic device) according to an embodiment of the disclosure.
[0020] FIG. **2**C is an exploded perspective view illustrating a wearable device (e.g. an electronic device) according to an embodiment of the disclosure.
[0021] FIGS. **3**A and **3**B are views illustrating a front surface and a rear surface of a wearable device (e.g., an electronic device) according to an embodiment.
[0022] FIG. **4** is a view illustrating a function or operation of, in a case in which a user wearing a wearable device rotates (e.g., shifting of gaze), highlighting and outputting a notification with respect to at least one external object while maintaining beamforming with respect to the at least one external object (e.g., a vehicle) according to an embodiment of the disclosure.
[0023] FIG. **5** is a view illustrating a function or operation of identifying a plurality of external objects located around a user wearing a wearable device and performing beamforming with respect to each of the identified a plurality of external objects according to an embodiment of the disclosure.
[0024] FIG. **6** is a view illustrating a function or operation of providing a notification with respect to a plurality of external objects through a wearable device according to an embodiment of the disclosure.
[0025] FIG. **7** is a view illustrating a function or operation of, in a case in which a user wearing a wearable device rotates (e.g., shifting of gaze) toward one of a plurality of external objects, maintaining beamforming with respect to the one external object according to an embodiment of the disclosure.
[0026] FIG. **8**A is a view illustrating a function or operation of highlighting a notification with respect to one external object and providing same to a user according to an embodiment of the disclosure.
[0027] FIGS. **8**B and **8**C are views illustrating various types of notifications with respect to a plurality of external objects according to an embodiment of the disclosure.
[0028] FIG. **9** is a view illustrating a function or operation of, in a case in which a user wearing a wearable device rotates (e.g., shifting of gaze) toward one of a plurality of external objects,

changing at least some of microphones which are performing beamforming to another microphone so as to maintain beamforming with respect to one object according to an embodiment of the disclosure.

[0029] FIG. **10** is a view illustrating a function or operation of performing beamforming with respect to a specific external object (e.g., a vehicle) by using some of a plurality of microphones according to an embodiment of the disclosure.

[0030] FIG. **11** is a view illustrating a function or operation of, in a case in which a user wearing a wearable device rotates by a specific angle (e.g., **0**), changing at least some of microphones which are performing beamforming to another microphone so as to maintain beamforming being performed with respect to a specific external object (e.g., a vehicle) according to an embodiment of the disclosure.

[0031] FIGS. **12**A, **12**B, and **12**C are views illustrating a function or operation of, in a case in which a user wearing a wearable device rotates by a specific angle (e.g., θ), maintaining directivity of a beam according to an embodiment of the disclosure.

[0032] FIG. **13** is a view illustrating a function or operation of, in a case in which a user wearing a wearable device rotates (e.g., shifting of gaze) toward a specific external object (e.g., a vehicle), switching to a video see through (VST) mode according to an embodiment of the disclosure.

[0033] FIG. **14** is a view illustrating a function or operation of determining a type of a notification, based on whether a sound signal generated from an external object located around a user wearing a wearable device is a sound signal included in a designated risk group, and providing the notification to the user according to the determined type of the notification according to an embodiment of the disclosure.

[0034] FIGS. **15**A and **15**B are views illustrating a type 1 notification and a type 2 notification according to an embodiment of the disclosure.

[0035] FIG. **16** is a view illustrating a function or operation of, in a case in which at least one external object is identified when a wearable device and an external electronic device are operatively connected, outputting a content sound together with a sound generated from at least one external object through the external electronic device according to an embodiment of the disclosure.

DETAILED DESCRIPTION

[0036] FIG. **1** is a block view illustrating an electronic device **101** in a network environment according to various embodiments of the disclosure.

[0037] FIG. **2**A is a perspective view illustrating a wearable device **200** according to an embodiment of the disclosure.

[0038] FIG. **2**B is a perspective view illustrating an inner configuration of a wearable device **200** according to an embodiment of the disclosure.

[0039] FIG. **2**C is an exploded perspective view illustrating a wearable device **200** according to an embodiment of the disclosure.

[0040] FIG. **1** is a block diagram illustrating an electronic device **101** in a network environment **100** according to various embodiments. Referring to FIG. **1**, the electronic device **101** in the network environment **100** may communicate with an electronic device **102** via a first network **198** (e.g., a short-range wireless communication network), or at least one of an electronic device **104** or a server **108** via a second network **199** (e.g., a long-range wireless communication network). According to an embodiment, the electronic device **101** may communicate with the electronic device **104** via the server **108**. According to an embodiment, the electronic device **101** may include a processor **120**, memory **130**, an input module **150**, a sound output module **155**, a display module **160**, an audio module **170**, a sensor module **176**, an interface **177**, a connecting terminal **178**, a haptic module **179**, a camera module **180**, a power management module **188**, a battery **189**, a communication module **190**, a subscriber identification module (SIM) **196**, or an antenna module **197**. In some embodiments, at least one of the components (e.g., the connecting terminal **178**) may be omitted from the electronic device **101**, or one or more other components may be added in the electronic device **101**. In some embodiments, some of the components (e.g., the sensor module **176**, the camera module **180**, or the antenna module **197**) may be implemented as a single component (e.g., the display module **160**).

[0041] The processor **120** may execute, for example, software (e.g., a program **140**) to control at least one other component (e.g., a hardware or software component) of the electronic device **101** coupled with the processor **120**, and may perform various data processing or computation. According to one embodiment, as at least part of the data processing or computation, the processor **120** may store a command or data received from another component (e.g., the sensor module **176** or the communication module **190**) in volatile memory **132**, process the command or the data stored in the volatile memory **132**, and store resulting data in non-volatile memory **134**. According to an embodiment, the processor **120** may include a main processor **121** (e.g., a central processing unit (CPU) or an application processor (AP)), or an auxiliary processor **123** (e.g., a graphics processing unit (GPU), a neural processing unit (NPU), an image signal processor (ISP), a sensor hub processor, or a communication processor (CP)) that is operable independently from, or in conjunction with, the main processor **121**. In an example in which the electronic device **101** includes the main processor **121** and the auxiliary processor **123**, the auxiliary processor **123** may be adapted to consume less power than the main processor **121**, or to be specific to a specified function. The auxiliary processor **123** may be implemented as separate from, or as part of the main processor **121**.

[0042] The auxiliary processor **123** may control at least some of functions or states related to at least one component (e.g., the display module **160**, the sensor module **176**, or the communication module **190**) among the components of the electronic device **101**, instead of the main processor **121** while the main processor **121** is in an inactive (e.g., sleep) state, or together with the main processor **121** while the main processor **121** is in an active state (e.g., executing an application). According to an embodiment, the auxiliary processor **123** (e.g., an image signal processor or a communication processor) may be implemented as part of another component (e.g., the camera module **180** or the communication module **190**) functionally related to the auxiliary processor **123**. According to an embodiment, the auxiliary processor **123** (e.g., the neural processing unit) may include a hardware structure specified for artificial intelligence model processing. An artificial intelligence model may be generated by machine learning. Such learning may be performed, e.g., by the electronic device **101** where the artificial intelligence is performed or via a separate server (e.g., the server **108**). Learning algorithms may include, but are not limited to, e.g., supervised learning, unsupervised learning, semi-supervised learning, or reinforcement learning. The artificial intelligence model may include a plurality of artificial neural network layers. The artificial neural network may be a deep neural network (DNN), a convolutional neural network (CNN), a recurrent neural network (RNN), a restricted Boltzmann machine (RBM), a deep belief network (DBN), a bidirectional recurrent deep neural network (BRDNN), deep Q-network or a combination of two or more thereof but is not limited thereto. The artificial intelligence model may, additionally or alternatively, include a software structure other than the hardware structure.

[0043] The memory **130** may store various data used by at least one component (e.g., the processor **120** or the sensor module **176**) of the electronic device **101**. The various data may include, for example, software (e.g., the program **140**) and input data or output data for a command related thereto. The memory **130** may include the volatile memory **132** or the non-volatile memory **134**.

[0044] The program **140** may be stored in the memory **130** as software, and may include, for example, an operating system (OS) **142**, middleware **144**, or an application **146**.

[0045] The input module **150** may receive a command or data to be used by another component (e.g., the processor **120**) of the electronic device **101**, from the outside (e.g., a user) of the electronic device **101**. The input module **150** may include, for example, a microphone, a mouse, a keyboard, a key (e.g., a button), or a digital pen (e.g., a stylus pen).

[0046] The sound output module **155** may output sound signals to the outside of the electronic device **101**. The sound output module **155** may include, for example, a speaker or a receiver. The speaker may be used for general purposes, such as playing multimedia or playing record. The receiver may be used for receiving incoming calls. According to an embodiment, the receiver may be implemented as separate from, or as part of the speaker.
[0047] The display module **160** may visually provide information to the outside (e.g., a user) of the electronic device **101**. The display module **160** may include, for example, a display, a hologram device, or a projector and control circuitry to control a corresponding one of the display, hologram device, and projector. According to an embodiment, the display module **160** may include a touch sensor adapted to detect a touch, or a pressure sensor adapted to measure the intensity of force incurred by the touch.
[0048] The audio module **170** may convert a sound into an electrical signal and vice versa. According to an embodiment, the audio module **170** may obtain the sound via the input module **150**, or output the sound via the sound output module **155** or a headphone of an external electronic device (e.g., an electronic device **102**) directly (e.g., wiredly) or wirelessly coupled with the electronic device **101**.
[0049] The sensor module **176** may detect an operational state (e.g., power or temperature) of the electronic device **101** or an environmental state (e.g., a state of a user) external to the electronic device **101**, and then generate an electrical signal or data value corresponding to the detected state. According to an embodiment, the sensor module **176** may include, for example, a gesture sensor, a gyro sensor, an atmospheric pressure sensor, a magnetic sensor, an acceleration sensor, a grip sensor, a proximity sensor, a color sensor, an infrared (IR) sensor, a biometric sensor, a temperature sensor, a humidity sensor, or an illuminance sensor.
[0050] The interface **177** may support one or more specified protocols to be used for the electronic device **101** to be coupled with the external electronic device (e.g., the electronic device **102**) directly (e.g., wiredly) or wirelessly. According to an embodiment, the interface **177** may include, for example, a high definition multimedia interface (HDMI), a universal serial bus (USB) interface, a secure digital (SD) card interface, or an audio interface.
[0051] A connecting terminal **178** may include a connector via which the electronic device **101** may be physically connected with the external electronic device (e.g., the electronic device **102**). According to an embodiment, the connecting terminal **178** may include, for example, a HDMI connector, a USB connector, a SD card connector, or an audio connector (e.g., a headphone connector).
[0052] The haptic module **179** may convert an electrical signal into a mechanical stimulus (e.g., a vibration or a movement) or electrical stimulus which may be recognized by a user via his tactile sensation or kinesthetic sensation. According to an embodiment, the haptic module **179** may include, for example, a motor, a piezoelectric element, or an electric stimulator.
[0053] The camera module **180** may capture a still image or moving images. According to an embodiment, the camera module **180** may include one or more lenses, image sensors, image signal processors, or flashes.
[0054] The power management module **188** may manage power supplied to the electronic device **101**. According to one embodiment, the power management module **188** may be implemented as at least part of, for example, a power management integrated circuit (PMIC).
[0055] The battery **189** may supply power to at least one component of the electronic device **101**. According to an embodiment, the battery **189** may include, for example, a primary cell which is not rechargeable, a secondary cell which is rechargeable, or a fuel cell.
[0056] The communication module **190** may support establishing a direct (e.g., wired) communication channel or a wireless communication channel between the electronic device **101** and the external electronic device (e.g., the electronic device **102**, the electronic device **104**, or the server **108**) and performing communication via the established communication channel. The

communication module **190** may include one or more communication processors that are operable independently from the processor **120** (e.g., the application processor (AP)) and supports a direct (e.g., wired) communication or a wireless communication. According to an embodiment, the communication module **190** may include a wireless communication module **192** (e.g., a cellular communication module, a short-range wireless communication module, or a global navigation satellite system (GNSS) communication module) or a wired communication module **194** (e.g., a local area network (LAN) communication module or a power line communication (PLC) module). A corresponding one of these communication modules may communicate with the external electronic device via the first network **198** (e.g., a short-range communication network, such as Bluetooth™ wireless-fidelity (Wi-Fi) direct, or infrared data association (IrDA)) or the second network **199** (e.g., a long-range communication network, such as a legacy cellular network, a 5G network, a next-generation communication network, the Internet, or a computer network (e.g., LAN or wide area network (WAN)). These various types of communication modules may be implemented as a single component (e.g., a single chip), or may be implemented as multi components (e.g., multi chips) separate from each other. The wireless communication module **192** may identify and authenticate the electronic device **101** in a communication network, such as the first network **198** or the second network **199**, using subscriber information (e.g., international mobile subscriber identity (IMSI)) stored in the subscriber identification module **196**.

[0057] The wireless communication module **192** may support a 5G network, after a 4G network, and next-generation communication technology, e.g., new radio (NR) access technology. The NR access technology may support enhanced mobile broadband (eMBB), massive machine type communications (mMTC), or ultra-reliable and low-latency communications (URLLC). The wireless communication module **192** may support a high-frequency band (e.g., the mmWave band) to achieve, e.g., a high data transmission rate. The wireless communication module **192** may support various technologies for securing performance on a high-frequency band, such as, e.g., beamforming, massive multiple-input and multiple-output (massive MIMO), full dimensional MIMO (FD-MIMO), array antenna, analog beam-forming, or large scale antenna. The wireless communication module **192** may support various requirements specified in the electronic device **101**, an external electronic device (e.g., the electronic device **104**), or a network system (e.g., the second network **199**). According to an embodiment, the wireless communication module **192** may support a peak data rate (e.g., 20 Gbps or more) for implementing eMBB, loss coverage (e.g., 164 dB or less) for implementing mMTC, or U-plane latency (e.g., 0.5 ms or less for each of downlink (DL) and uplink (UL), or a round trip of 1 ms or less) for implementing URLLC.

[0058] The antenna module **197** may transmit or receive a signal or power to or from the outside (e.g., the external electronic device) of the electronic device **101**. According to an embodiment, the antenna module **197** may include an antenna including a radiating element composed of a conductive material or a conductive pattern formed in or on a substrate (e.g., a printed circuit board (PCB)). According to an embodiment, the antenna module **197** may include a plurality of antennas (e.g., array antennas). In such a case, at least one antenna appropriate for a communication scheme used in the communication network, such as the first network **198** or the second network **199**, may be selected, for example, by the communication module **190** (e.g., the wireless communication module **192**) from the plurality of antennas. The signal or the power may then be transmitted or received between the communication module **190** and the external electronic device via the selected at least one antenna. According to an embodiment, another component (e.g., a radio frequency integrated circuit (RFIC)) other than the radiating element may be additionally formed as part of the antenna module **197**.

[0059] According to various embodiments, the antenna module **197** may form a mmWave antenna module. According to an embodiment, the mmWave antenna module may include a printed circuit board, a RFIC disposed on a first surface (e.g., the bottom surface) of the printed circuit board, or adjacent to the first surface and capable of supporting a designated high-frequency band (e.g., the mmWave band), and a plurality of antennas (e.g., array antennas) disposed on a second surface (e.g., the top or a side surface) of the printed circuit board, or adjacent to the second surface and capable of transmitting or receiving signals of the designated high-frequency band.

[0060] At least some of the above-described components may be coupled mutually and communicate signals (e.g., commands or data) therebetween via an inter-peripheral communication scheme (e.g., a bus, general purpose input and output (GPIO), serial peripheral interface (SPI), or mobile industry processor interface (MIPI)).

[0061] According to an embodiment, commands or data may be transmitted or received between the electronic device **101** and the external electronic device **104** via the server **108** coupled with the second network **199**. Each of the electronic devices **102** or **104** may be a device of a same type as, or a different type, from the electronic device **101**. According to an embodiment, all or some of operations to be executed at the electronic device **101** may be executed at one or more of the external electronic devices **102**, **104**, or **108**. For example, if the electronic device **101** should perform a function or a service automatically, or in response to a request from a user or another device, the electronic device **101**, instead of, or in addition to, executing the function or the service, may request the one or more external electronic devices to perform at least part of the function or the service. The one or more external electronic devices receiving the request may perform the at least part of the function or the service requested, or an additional function or an additional service related to the request, and transfer an outcome of the performing to the electronic device **101**. The electronic device **101** may provide the outcome, with or without further processing of the outcome, as at least part of a reply to the request. To that end, a cloud computing, distributed computing, mobile edge computing (MEC), or client-server computing technology may be used, for example. The electronic device **101** may provide ultra low-latency services using, e.g., distributed computing or mobile edge computing. In another embodiment, the external electronic device **104** may include an internet-of-things (IoT) device. The server **108** may be an intelligent server using machine learning and/or a neural network. According to an embodiment, the external electronic device **104** or the server **108** may be included in the second network **199**. The electronic device **101** may be applied to intelligent services (e.g., smart home, smart city, smart car, or healthcare) based on 5G communication technology or IoT-related technology.

[0062] FIG. **2**A is a perspective view illustrating a wearable device **200** according to an embodiment of the disclosure.

[0063] Referring to FIG. **2**A, the wearable device **200** may include a glasses-type electronic device and a user may visually recognize an object or environment therearound while wearing the wearable device **200**. For example, the wearable device **200** may include a head mounting device (HMD) or smart glasses which may directly provide an image in front of the user's eye. The configuration of the wearable device **200** of FIG. **2**A may be entirely or partially identical to that of the electronic device **101** of FIG. **1**.

[0064] According to various embodiments, the wearable device **200** may include a housing **210** configuring an exterior of the wearable device **200**. The housing **210** may provide a space in which components of the wearable device **200** may be arranged. For example, the housing **210** may include a lens frame **202** and at least one wearing member **203**.

[0065] According to various embodiments, the wearable device **200** may include at least one display member **201** capable of providing visual information to a user. For example, the display member **201** may include a module to which a lens or a second window member, a display, a waveguide, and/or a touch circuit is mounted. According to an embodiment, the display member **201** may be configured to be transparent or translucent. According to an embodiment, the display member **201** may include glass formed by a translucent material or a window member of which light transmittance may be adjusted by adjusting a coloring density. According to an embodiment, a pair of display members **201** may be provided and arranged to correspond to a right eye and a left eye of a user, respectively, while the wearable device **200** is worn on the user's body.

[0066] According to various embodiments, the lens frame **202** may receive at least a portion of the display member **201**. For example, the lens frame **202** may surround at least a portion of an edge of the display member **201**. According to another embodiment, the lens frame **202** may locate at least one of the display member **201** to correspond to a user's eye. According to an embodiment, the lens frame **202** may include a rim of a general glasses structure. According to an embodiment, the lens frame **202** may include at least one closed curved line for surrounding the display member **201**.
[0067] According to various embodiments, the wearing member **203** may extend from the lens frame **202**. For example, the wearing member **203** may extend from an end portion of the lens frame **202** and may be supported by or located on the user's body (e.g., the ear) together with the lens frame **202**. According to an embodiment, the wearing member **203** may be rotatably coupled to the lens frame **202** through a hinge structure **229**. According to an embodiment, the wearing member **203** may include an inner lateral surface **231***c* configured to face a user's body and an outer lateral surface **231***d* opposite to the inner lateral surface.
[0068] According to various embodiments, the wearable device **200** may include a hinge structure **229** configured to allow the wearing member **203** to be foldable with respect to the lens frame **202**. The hinge structure **229** may be disposed between the lens frame **202** and the wearing member **203**. In a state of not wearing the wearable device **200**, the user may carry or store the wearable device by folding the wearing member **203** such that a portion thereof partially overlaps the lens frame **202**.
[0069] FIG. **2**B is a perspective view illustrating an internal configuration of a wearable device according to an embodiment of the disclosure. FIG. **2**C is an exploded perspective view of a wearable device according to an embodiment of the disclosure.
[0070] Referring to FIGS. **2**B and **2**C, the wearable device **200** may include components (e.g., at least one circuit board **241** (e.g., a printed circuit board (PCB), a printed board assembly (PBA), a flexible PCB (FPCB), or a rigid-flexible PCB (RFPCB)), at least one battery **243**, at least one speaker module **245**, at least one power transfer structure **246**, and a camera module **250**) received in the housing **210**. The configuration of the housing **210** in FIG. **2**B may be entirely or partially identical to the configuration of the display member **201**, the lens frame **202**, the wearing member **203**, and the hinge structure **229** of FIG. **2**A.
[0071] According to various embodiments, the wearable device **200** may acquire and/or recognize a visual image related to an object or environment in a direction the user views or the wearable device **200** is directed (e.g., the −Y direction) by using the camera module **250** (e.g., the camera module **180** in FIG. **1**) and may be provided with information on the object or environment from an external electronic device (e.g., the electronic device **102** or **104** or the server **108** in FIG. **1**) through a network (e.g., the first network **198** or the second network **199** in FIG. **1**). In an embodiment, the wearable device **200** may provide the provided information on the object or environment to the user in an audio or visual form. The wearable device **200** may provide the provided information on the object or environment to the user in a visual form by using a display module (e.g., the display module **160** in FIG. **1**) through the display member **201**. For example, as the wearable device **200** realizes the information on the object or environment in a visual form to be combined with a real image of a surrounding environment of the user, the wearable device **200** may implement the augmented reality.
[0072] According to various embodiments, the display member **201** may include a first surface F**1** facing a direction (e.g., the −Y direction) in which light is incident and a second surface F**2** facing a direction (e.g., the +Y direction) opposite to the first surface F**1**. In a state in which the user wears the wearable device **200**, light incident through the first surface F**1** or at least a portion of an image may pass through the second surface F**2** of the display member **201** disposed to face the right eye and/or the left eye of the user to be incident to the right eye and/or the left eye of the user.
[0073] According to various embodiments, the lens frame **202** may include two or more frames. For example, the lens frame **202** may include a first frame **202***a* and a second frame **202***b*.

According to an embodiment, in a case in which the user wears the wearable device **200**, the first frame **202***a* may correspond to a frame of a portion facing the user's face and the second frame **202***b* may correspond to a portion of the lens frame **202** spaced apart in a direction of the user's gaze (e.g., the −Y direction) with respect to the first frame **202***a*.
[0074] According to various embodiments, a light output module **211** may provide an image and/or moving image to the user. For example, the light output module **211** may include a display panel (not illustrated) capable of outputting an image and a lens (not illustrated) corresponding to the user's eye and guiding the image to the display member **201**. For example, the user may acquire an image output from the display panel of the light output module **211** through the lens of the light output module **211**. According to various embodiments, the light output module **211** may include a device configured to display various information. For example, the light output module **211** may include at least one of a liquid crystal display (LCD), a digital mirror display device (digital mirror device, DMD), a liquid crystal on silicon (LCoS), an organic light-emitting diode (OLED), or a micro light emitting diode (micro LED). According to an embodiment, in a case in which the light output module **211** and/or the display member **201** includes one of a LCD, a DMD, or a LCoS, the wearable device **200** may include a light source configured to emit light to a display area of the light output module **211** and/or the display member **201**. According to an embodiment, in a case in which the light output module **211** and/or the display member **201** includes one of an OLED or a micro-LED, the wearable device **200** may provide a virtual image to the user without including a separate light source.
[0075] According to various embodiments, at least a portion of the light output module **211** may be disposed in the housing **210**. For example, the light output module **211** may be disposed in the wearing member **203** or the lens frame **202** to correspond to the user's right and left eyes, respectively. According to an embodiment, the light output module **211** may be connected to the display member **201** and may provide an image to the user through the display member **201**.
[0076] According to various embodiments, a circuit board **241** may include components for driving the wearable device **200**. For example, the circuit board **241** may include at least one integrated circuit chip and at least one of the processor **120**, the memory **130**, the power management module **188**, or the communication module **190** of FIG. **1** may be provided on the integrated chip. According to an embodiment, the circuit board **241** may be disposed in the wearing member **203** of the housing **210**. According to an embodiment, the circuit board **241** may be electrically connected to the battery **243** through the power transfer structure **246**. According to an embodiment, the circuit board **241** may be connected to the flexible printed circuit board **205** and may transfer an electrical signal to electronic components (e.g., the light output module **211**, the camera module **250**, and a light-emitting part) of the electronic device through the flexible printed circuit board **205**. According to an embodiment, the circuit board **241** may correspond to a circuit board including an interposer.
[0077] According to various embodiments, the flexible printed circuit board **205** may extend from the circuit board **241** to an inside of the lens frame **202** via the hinge structure **229** and may be disposed on at least a portion of a circumference of the display member **201** inside the lens frame **202**.
[0078] According to various embodiments, the battery **243** (e.g., the battery **189** in FIG. **1**) may be electrically connected to components (e.g., the light output module **211**, the circuit board **241**, the speaker module **245**, the microphone module **247**, and the camera module **250**) of the wearable device **200** and may provide power to the components of the wearable device **200**.
[0079] According to various embodiments, at least a portion of the battery **243** may be disposed in the wearing member **203**. According to an embodiment, the battery **243** may be disposed at an end portion **203***a* or **203***b* of the wearing member **203**. For example, the battery **243** may include a first battery **243***a* disposed at a first end portion **203***a* and a second battery **243***b* disposed at a second end portion **203***b* of the wearing member **203**.

[0080] According to various embodiments, the speaker module **245** (e.g., the audio module **170** or the sound output module **155** in FIG. **1**) may convert an electrical signal into a sound. At least a portion of the speaker module **245** may be disposed in the wearing member **203** of the housing **210**. According to an embodiment, the speaker module **245** may be disposed in the wearing member **203** to correspond to the user's ear. For example, the speaker module **245** may be disposed between the circuit board **241** and the battery **243**.
[0081] According to various embodiments, the power transfer structure **246** may transfer power of the battery **243** to an electronic component (e.g., the light output module **211**) of the wearable device **200**. For example, the power transfer structure **246** may be electrically connected to the battery **243** and/or the circuit board **241**, and the circuit board **241** may transfer power received through the power transfer structure **246** to the light output module **211**. According to an embodiment, the power transfer structure **246** may be connected to the circuit board **241** via the speaker module **245**. In an example in which viewing the wearable device **200** from the lateral surface (e.g., the Z-axis direction), the power transfer structure **246** may at least partially overlap the speaker module **245**.
[0082] According to various embodiments, the power transfer structure **246** may correspond to a configuration capable of transferring power. For example, the power transfer structure **246** may include a flexible printed circuit board or a wire. For example, the wire may include a plurality of cables (not illustrated). In various embodiments, a form of the power transfer structure **246** may be variously changed according to the number and/or type of cables.
[0083] According to various embodiments, the microphone module **247** (e.g., the input module **150** and/or the audio module **170** in FIG. **1**) may convert a sound into an electrical signal. According to an embodiment, the microphone module **247** may be disposed on at least a portion of the lens frame **202**. For example, at least one microphone module **247** may be disposed on a lower end (e.g., a direction facing the −X axis) and/or an upper end (e.g., a direction facing the X axis) of the wearable device **200**. According to various embodiments, the wearable device **200** may recognize a user's voice more clearly by using voice information (e.g., a sound) acquired by at least one microphone module **247**. For example, the wearable device **200** may distinguish voice information and peripheral noise based on the acquired voice information and/or additional information (e.g., a low-frequency vibration of the user's skin and bones). For example, the wearable device **200** may clearly recognize the user's voice and perform a function (e.g., noise canceling) for reducing peripheral noise. The microphone module **247** according to an embodiment of the disclosure may include a plurality of microphone modules **247** configured to perform beamforming. The microphone module **247** according to an embodiment of the disclosure may include an omnidirectional or directional microphone.
[0084] According to various embodiments, the camera module **250** may capture a still image and/or video. The camera module **250** may include at least one of a lens, at least one image sensor, an image signal processor, or a flash. According to an embodiment, the camera module **250** may be disposed within the lens frame **202** and around the display member **201**.
[0085] According to various embodiments, the camera module **250** may include at least one first camera module **251**. According to an embodiment, the first camera module **251** may capture the user's eye (e.g., a pupil) or a trajectory of a gaze. For example, the first camera module **251** may capture a reflection pattern of light emitted by the light-emitting part to the user's eye. For example, the light-emitting part **330** may emit light in an infrared band for tracking a trajectory of a gaze by using the first camera module **251**. For example, the light-emitting part **330** may include an IR LED. According to an embodiment, a processor (e.g., the processor **120** in FIG. **1**) may adjust a location of a virtual image such that the virtual image projected to the display member **201** corresponds to a direction in which the user's eye gazes. According to an embodiment, the first camera module **251** may include a global shutter (GS) type camera and a trajectory of the user's eyes or gaze by using may be tracked by using a plurality of first camera modules **251** of the same

standard and performance.

[0086] According to various embodiments, the first camera module **251** may periodically or aperiodically transmit information (e.g., trajectory information) on tracking of a trajectory of the user's eye or gaze to the processor (e.g., the processor **120** in FIG. **1**). According to an embodiment, when detecting that the user's gaze is changed (e.g., moving more than a reference value in a state in which the head does not move) based on the trajectory information, the first camera module **251** may transmit the trajectory information to the processor.

[0087] According to various embodiments, the camera module **250** may include a second camera module **253**. According to an embodiment, the second camera module **253** may capture an image of the outside. According to an embodiment, the second camera module **253** may include a global shutter or rolling shutter (RS) type camera. According to an embodiment, the second camera module **253** may capture an image of the outside through a second optical hole **223** disposed through the second frame **202***b*. For example, the second camera module **253** may include a high-resolution color camera and correspond to a high resolution (HP) or photo video (PV) camera. In some aspects, the second camera module **253** may provide an auto focus (AF) and image stabilization function (optical image stabilizer (OIS)).

[0088] According to various embodiments, the wearable device **200** may include a flash (not illustrated) located adjacent to the second camera module **253**. For example, the flash (not illustrated) may provide light for increasing brightness (e.g., illuminance) of a periphery of the wearable device **200** when the second camera module **253** acquires an external image and may reduce image acquisition difficulties due to dark environments, incorporation of various light sources, and/or reflections of light.

[0089] According to various embodiments, the camera module **250** may include at least one third camera module **255**. According to an embodiment, the third camera module **255** may capture an operation of the user through the first optical hole **221** disposed through the lens frame **202**. For example, the third camera module **255** may capture a user's gesture (e.g., a hand motion). The third camera module **255** and/or the first optical hole **221** may be disposed at opposite lateral ends of the lens frame **202** (e.g., the second frame **202***b*), for example, at opposite ends of the lens frame **202** (e.g., the second frame **202***b*) in the X direction, respectively. According to an embodiment, the third camera module **255** may include a global shutter (GS) type camera. For example, the third camera module **255** may correspond to a camera for supporting 3 degrees of freedom (3DoF) or 6DoF and 360-degree space (e.g., omnidirectional) location recognition, and/or movement recognition. According to an embodiment, the third camera module **255** may perform a moving path tracking function (simultaneous localization and mapping (SLAM)) and a user movement recognition function by using a plurality of global shutter-type cameras having an identical specification and performance as a stereo camera. According to an embodiment, the third camera module **255** may include an infrared (IR) camera (e.g., a time of flight (TOF) camera or structured light camera). For example, the IR camera may operate as at least a portion of a sensor module (e.g., the sensor module **176** in FIG. **1**) for detecting a distance to an object.

[0090] According to an embodiment, at least one of the first camera module **251** or the third camera module **255** may be replaced with a sensor module (e.g., the sensor module **176** in FIG. **1**) (e.g., a Lidar sensor). For example, the sensor module may include at least one of a vertical cavity surface emitting laser (VCSEL), an infrared sensor, and/or a photodiode. For example, the photodiode may include a positive intrinsic negative (PIN) photodiode or an avalanche photo diode (APD). The photodiode may be referred to as a photo detector or a photo sensor.

[0091] According to an embodiment, at least one of the first camera module **251**, the second camera module **253**, or the third camera module **255** may include a plurality of camera modules (not illustrated). For example, the second camera module **253** may include a plurality of lenses (e.g., wide-angle and telephoto lenses) and image sensors and may be disposed on a surface (e.g., a surface facing the −Y axis) of the wearable device **200**. For example, the wearable device **200** may include a plurality of camera modules having different properties (e.g., an angle of view) or functions and control to change angles of view of camera modules based on a user's selection and/or trajectory information. For example, at least one of the plurality of camera modules may correspond to a wide-angle camera and at least another one may correspond to a telephoto camera.

[0092] According to various embodiments, the processor (e.g., the processor **120** in FIG. **1**) may determine movement of the wearable device **200** and/or movement of the user based on information of the wearable device **200** acquired by using at least one of a gesture sensor, a gyro sensor, or an acceleration sensor of the sensor module (e.g., the sensor module **176** in FIG. **1**) and an operation (e.g., approach of the user to the wearable device **200**) of the user acquired by using the first camera module **251**. According to an embodiment, in addition to the sensors described herein, the wearable device **200** may include a magnetic (geomagnetic) sensor that may measure a direction using a magnetic field and magnetic line of force, and/or a Hall sensor that may acquire movement information (e.g., a movement direction or movement distance) using a strength of a magnetic field. For example, the processor may determine movement of the wearable device **200** and/or movement of the user based on information acquired from a magnetic (geomagnetic) sensor and/or a Hall sensor.

[0093] According to various embodiments (not illustrated), the wearable device **200** may perform an input function (e.g., a touch and/or pressure detection function) which allows interaction with the user. For example, a component (e.g., a touch sensor and/or pressure sensor) configured to perform a touch and/or pressure detection function may be disposed on at least a portion of the wearing member **203**. The wearable device **200** may control a virtual image output through the display member **201** based on information acquired through the components. For example, a sensor related to a touch and/or pressure detection function may be configured in various types, such as a resistive type, a capacitive type, an electro-magnetic type (EM), or an optical type. According to an embodiment, the component configured to perform the touch and/or pressure detection function may be entirely or partially identical to the input module **150** in FIG. **1**.

[0094] According to various embodiments, the wearable device **200** may include a reinforcement member **260** disposed in an internal space of the lens frame **202** and formed to have a rigidity higher than that of the lens frame **202**.

[0095] According to various embodiments, the wearable device **200** may include a lens structure **270**. The lens structure **270** may refract at least a portion of light. For example, the lens structure **270** may correspond to a prescription lens having refractive power. According to an embodiment, the lens structure **270** may be disposed in a rear side (e.g., the +Y direction) of a second window member of the display member **201**. For example, the lens structure **270** may be disposed between the display member **201** and the user's eye. For example, the lens structure **270** may face the display member.

[0096] According to various embodiments, the housing **210** may include a hinge cover **227** capable of covering a portion of the hinge structure **229**. Another portion of the hinge structure **229** may be received between or covered by an inner case **231** and an outer case **233** which will be described herein.

[0097] According to various embodiments, the wearing member **203** may include the inner case **231** and the outer case **233**. The inner case **231** may correspond to, for example, a case configured to face the user's body or come into direct contact with the user's body and may be manufactured by a material with low thermal conductivity such as a resin. According to an embodiment, the inner case **231** may include an inner lateral surface (e.g., the inner lateral surface **231***c* in FIG. **2**A) facing the user's body. The outer case **233** may include, for example, a material (e.g., a metallic material) capable of at least partially transferring heat and may be coupled to face the inner case **231**. According to an embodiment, the outer case **233** may include an outer surface (e.g., the outer surface **231***d* in FIG. **2**A) opposite to the internal surface **231***c*. In an embodiment, at least one of the circuit board **241** or the speaker module **245** may be received in a space separated from the battery **243** within the wearing member **203**. In the described embodiment, the inner case **231** may include a first case **231***a* including the circuit board **241** or the speaker module **245** and a second case **231***b* for receiving the battery **243**, and the outer case **233** may include a third case **233***a* coupled to face the first case **231***a* and a fourth case **233***d* coupled to face the second case **231***b*. For example, the first case **231***a* and the third case **233***a* may be coupled (hereinafter, a "first case part **231***a* or third case part **233***a*") to receive the circuit board **241** and/or the speaker module **245**, and the second case **231***b* and the fourth case **233***b* may be coupled (hereinafter, a "second case part **231***b* or fourth case part **233***b*") to receive the battery **243**.

[0098] According to various embodiments, the first case **231***a* and the third case part **233***a* may be rotatably coupled to the lens frame **202** through the hinge structure **229**, and the second case part **231***b* and the fourth case part **233***b* may respectively be connected or mounted to end portions of the first case part **231***a* and the third case part **233***a* through the connection member **235**. In some embodiments, a portion of the connection member **235**, which comes in contact with the user's body, may be manufactured of a material having a low heat conductivity, for example, an elastic material such as silicone or polyurethane, and a portion not in contact with the user's body may be manufacture of a material (e.g., a metallic material) having a high conductivity. For example, in a case in which heat is generated from the circuit board **241** or the battery **243**, the connection member **235** may block the heat from being transferred to the portion coming in contact with the user's body and disperse or dissipate the heat through the portion not in contact with the user's body. According to an embodiment, the portion of the connection member **235**, which is configured to come in contact with the user's body, may be interpreted as a portion of the inner case **231**, and the portion of the connection member **235**, which is not in contact with the user's body may be interpreted as a portion of the outer case **233**. According to an embodiment (not illustrated), the first case **231***a* and the second case **231***b* may be integrally formed without the connection member **235**, and the third case **233***a* and the fourth case **233***b* may be integrally formed without the connection member **235**. According to various embodiments, other components (e.g., the antenna module **197** in FIG. **1**) may be further included in addition to the aforementioned components, and information on the object or environment may be provided from an external electronic device (e.g., the external electronic device **102** of **104** or the server **108** in FIG. **1**) through the network (e.g., the first network **198** or the second network **199** in FIG. **1**) by using the communication module **190**.

[0099] Only the wearable devices **200** is illustrated and described in FIGS. **2**A to **2**C, but it is not limited thereto, and a portion of the configuration of the wearable device **200** illustrated in FIGS. **2**A to **2**C may be included in an electronic device, such as a smartphone or a tablet PC.

[0100] FIGS. **3**A and **3**B are views illustrating a front surface and a rear surface of a wearable electronic device **101** according to an embodiment.

[0101] Referring to FIGS. **3**A and **3**B, in an embodiment, a depth sensor **317** and/or camera modules **311**, **312**, **313**, **314**, **315**, and **316** for acquiring information related to a peripheral environment of the wearable electronic device **101** may be arranged on a first surface **310** of a housing.

[0102] In an embodiment, the camera modules **311** and **312** may acquire an image related to a peripheral environment of the wearable electronic device.

[0103] In an embodiment, the camera modules **313**, **314**, **315**, and **316** may acquire an image in a state where the wearable electronic device is worn by the user. An image acquired through the camera modules **313**, **314**, **315**, and **316** may be used for simultaneous localization and mapping (SLAM), 6 degrees of freedom (6DoF), 3 degrees of freedom (3DoF), subject recognition, and/or tracking, and a user's hand may be recognized and/or tracked and used as an input to the wearable electronic device.

[0104] In an embodiment, the depth sensor **317** may be configured to transmit a signal and receive a signal reflected from a subject and may be used to identify a distance to an object, such as time of flight (TOF).

[0105] According to an embodiment, a face recognition camera module **325** or **326** and/or a display **321** (and/or a lens) may be arranged on a second surface **320** of the housing.
[0106] In an embodiment, the face recognition camera module **325** or **326** adjacent to the display may be used to recognize the user's face or may recognize and/or track both eyes of the user.
[0107] In an embodiment, the display **321** (and/or the lens) may be disposed on the second surface **320** of the wearable electronic device **101**. In an embodiment, the wearable electronic device **101** may not include the camera modules **315** and **316** among a plurality of camera modules **313**, **314**, **315**, and **316**. Although not illustrated in FIGS. **3**A and **3**B, the wearable electronic device **101** may further include at least one of components illustrated in FIGS. **2**A to **2**C.
[0108] As described herein, the wearable electronic device **101** according to an embodiment may have a form factor to be mounted on the user's head. The wearable electronic device **101** may further include a strap and/or wearing member (e.g., the wearing member **203** in FIGS. **2**A to **2**C) for securing the wearable electronic device onto a user's body part. The wearable electronic device **101** may provide a user experience based on augmented reality, virtual reality, and/or mixed reality in a state of being mounted on the user head.
[0109] FIG. **4** is a view illustrating a function or operation of, in a case in which a user wearing a wearable device **200** rotates (e.g., shifting of gaze), highlighting and outputting a notification with respect to at least one external object (e.g., a vehicle **510**) while maintaining beamforming with respect to the at least one external object (e.g., the vehicle **510**) according to an embodiment of the disclosure.
[0110] Referring to FIG. **4**, the wearable device **200** (e.g., the electronic device **101** in FIG. **1**) according to an embodiment of the disclosure, in operation **410**, may perform beamforming with respect to at least one external object (e.g., the vehicle **510**, an animal **520**, or a falling object **530**) located around the user **500** wearing the wearable device **200** by using at least one microphone (e.g., a first microphone **247***a* and a second microphone **247***b*) among a plurality of microphones (e.g., the microphone module **247**). The wearable device **200** according to an embodiment of the disclosure may identify at least one external object (e.g., the vehicle **510**, the animal **520**, and/or the falling object **530**) located around the user **500** wearing the wearable device **200** by analyzing (e.g., comparing a shape of an external object with a shape stored in the wearable device **200**) an image captured by at least one camera (e.g., the second camera module **253**) capable of capturing a periphery of the user **500** wearing the wearable device **200**. Descriptions herein of an object located “around” the user **500** or the wearable device **200** may refer to the object being located within a predetermined distance or area with respect to the object. The predetermined distance or area may be a distance or area according to which the wearable device **200** is capable of detecting objects (e.g., using sensing devices or sensor modules of the wearable device **200** (for example, a camera, a microphone, or the like), or using wireless communication devices) in accordance with one or more embodiments of the present disclosure. In some aspects, descriptions of an object located “around” the user **500** or the wearable device **200** may refer objects which have been identified (e.g., as later described with reference to FIG. **5**) by the wearable device **200**.
[0111] According to an embodiment of the disclosure, the at least one external object (e.g., the vehicle **510**, the animal **520**, and/or the falling object **530**) may have been designated by the user **500**. For example, the wearable device **200** according to an embodiment of the disclosure may provide a user interface (e.g., a screen) including various types of objects to designate at least one external object (e.g., the vehicle **510**, the animal **520**, and/or the falling object **530**). According to an embodiment of the disclosure, the wearable device **200**, based on user input with respect to the user interface (e.g., a screen), may determine at least one external object (e.g., the vehicle **510**, the animal **520**, and/or the falling object **530**) corresponding to an object to be identified. According to an embodiment of the disclosure, the wearable device **200**, based on a sound signal generated from at least one external object (e.g., the vehicle **510**, the animal **520**, and/or the falling object **530**), may identify at least one external object (e.g., the vehicle **510**, the animal **520**, and/or the falling

object **530**) (e.g., determine at least one external object as an object on which beamforming is to be performed). According to an embodiment of the disclosure, the wearable device **200** may compare the sound signal generated from the at least one external object (e.g., the vehicle **510**, the animal **520**, and/or the falling object **530**) with a stored or learned sound signal. According to an embodiment of the disclosure, the wearable device **200** may determine a type of the external object (e.g., identify what external object is) by comparing the sound signals.

[0112] According to an embodiment of the disclosure, the wearable device **200**, based a gaze of the user **500** identified through the camera module (e.g., the first camera module **251**), may identify at least one external object (e.g., the vehicle **510**, the animal **520**, and/or the falling object **530**). According to an embodiment of the disclosure, the wearable device **200**, in a case in which the user **500** is gazing at a specific object for a designated time or more, may identify a type of the object which the user **500** is gazing at, based on an image captured by the camera module (e.g., the second camera module **253**). According to an embodiment of the disclosure, the wearable device **200** may also determine the object which the user **500** is gazing for a designated time or more as an object on which beamforming is to be performed.

[0113] FIG. **5** is a view illustrating a function or operation of identifying a plurality of external objects (e.g., the vehicle **510**, the animal **520**, and/or the falling object **530**) located around a user wearing the wearable device **200** and performing beamforming with respect to each of the identified a plurality of external objects (e.g., the vehicle **510**, the animal **520**, and/or the falling object **530**) according to an embodiment of the disclosure. The wearable device **200** according to an embodiment of the disclosure may perform beamforming with respect to the identified object (e.g., toward the identified object). According to an embodiment of the disclosure, the wearable device **200** may identify a location of at least one external object (e.g., the vehicle **510**, the animal **520**, and/or the falling object **530**) based on an image captured by at least one camera (e.g., the second camera module **253**), and, based on the identified location, may perform beamforming through the microphone module **247** (e.g., a first microphone **247***a*, a second microphone **247***b*, a third microphone **247***c*, a fourth microphone **247***d*, a fifth microphone **247***e*, a sixth microphone **247***f*, a seventh microphone **247***g*, an eighth microphone **247***h*, and/or a ninth microphone **247***i*). According to an embodiment of the disclosure, the wearable device **200** may perform beamforming through the microphone module **247** (e.g., the first microphone **247***a*, the second microphone **247***b*, the third microphone **247***c*, the fourth microphone **247***d*, the fifth microphone **247***e*, the sixth microphone **247***f*, the seventh microphone **247***g*, the eighth microphone **247***h*, and/or the ninth microphone **247***i*) toward a sound signal generated from at least one external object (e.g., the vehicle **510**, the animal **520**, and/or the falling object **530**). According to an embodiment of the disclosure, the wearable device **200** may perform beamforming through the microphone module **247** (e.g., the first microphone **247***a*, the second microphone **247***b*, the third microphone **247***c*, the fourth microphone **247***d*, the fifth microphone **247***e*, the sixth microphone **247***f*, the seventh microphone **247***g*, the eighth microphone **247***h*, and/or the ninth microphone **247***i*) with respect to at least one external object (e.g., the vehicle **510**, the animal **520**, and/or the falling object **530**) in the line of sight that the user **500** is gazing at.

[0114] According to an embodiment of the disclosure, the wearable device **200** may perform beamforming using at least one microphone disposed in a direction in which at least one external object (e.g., the vehicle **510**, the animal **520**, and/or the falling object **530**) is located. For example, the wearable device **200** according to an embodiment of the disclosure, in the case of identifying that at least one object (e.g., the vehicle **510**) is located at the right rear side of the user **500** (e.g., approaching toward the user) as illustrated in FIG. **5**, may perform beamforming (e.g., establish a first beam area **510***a*) by using some microphones (e.g., the seventh microphone **247***g*, the eighth microphone **247***h*, and/or the ninth microphone **247***i*) disposed on the right side among the a plurality of microphones (e.g., the first microphone **247***a*, the second microphone **247***b*, the third microphone **247***c*, the fourth microphone **247***d*, the fifth microphone **247***e*, the sixth microphone

247*f*, the seventh microphone **247***g*, the eighth microphone **247***h*, and/or the ninth microphone **247***i*). According to an embodiment of the disclosure, the wearable device **200**, in the case of identifying that at least one object (e.g., the animal **520**) is located at the left front side of the user **500** (e.g., approaching toward the user) as illustrated in FIG. **5**, may perform beamforming (e.g., establish a second beam area **520***a*) by using some microphones (e.g., the second microphone **247***b*, the third microphone **247***c*, and/or the fourth microphone **247***d*) disposed on the left front side among the a plurality of microphones (e.g., the first microphone **247***a*, the second microphone **247***b*, the third microphone **247***c*, the fourth microphone **247***d*, the fifth microphone **247***e*, the sixth microphone **247***f*, the seventh microphone **247***g*, the eighth microphone **247***h*, and/or the ninth microphone **247***i*). According to an embodiment of the disclosure, the wearable device **200**, in the case of identifying that at least one object (e.g., the falling object **530**) is located in the left direction of the user **500** (e.g., falling around the user **500**) as illustrated in FIG. **5**, may perform beamforming (e.g., establish a third beam area **530***a*) by using some microphones (e.g., the first microphone **247***a*, the second microphone **247***b*, and/or the third microphone **247***c*) disposed in the left direction among the a plurality of microphones (e.g., the first microphone **247***a*, the second microphone **247***b*, the third microphone **247***c*, the fourth microphone **247***d*, the fifth microphone **247***e*, the sixth microphone **247***f*, the seventh microphone **247***g*, the eighth microphone **247***h*, and/or the ninth microphone **247***i*).

[0115] According to an embodiment of the disclosure, at least one microphone to perform beamforming may have been designated according to the location of the at least one external object (e.g., the vehicle **510**, the animal **520**, and/or the falling object **530**). For example, according to an embodiment of the disclosure, an area around the user **500** may be partitioned and each of the partitioned areas may have at least one microphone matched to perform beamforming. According to an embodiment of the disclosure, the at least one microphone to perform beamforming may be designated by the user **500**,

[0116] According to an embodiment of the disclosure, the wearable device **200** (e.g., the electronic device **101** in FIG. **1**), in operation **420**, may output a notification corresponding to at least one external object (e.g., the vehicle **510**, the animal **520**, and/or the falling object **530**). FIG. **6** is a view illustrating a function or operation of providing a notification (e.g., a first visual notification **610**, a second visual notification **620**, a third visual notification **630**, an sound notification **640**, and/or a tactile notification) with respect to a plurality of external objects (e.g., the vehicle **510**, the animal **520**, and/or the falling object **530**) through a wearable device according to an embodiment of the disclosure. According to an embodiment of the disclosure, the wearable device **200** may provide a virtual object (e.g., the first visual notification **610**, the second visual notification **620**, and/or the third visual notification **630**) as a notification (e.g., the first visual notification **610**, the second visual notification **620**, the third visual notification **630**, and/or the sound notification **640**) corresponding to at least one external object (e.g., the vehicle **510**, the animal **520**, and/or the falling object **530**) or the sound notification **640** (e.g., a notification designated according to an external object or a sound signal generated from at least one external object (e.g., the vehicle **510**, the animal **520**, and/or the falling object **530**)). According to an embodiment of the disclosure, the wearable device **200** may control the display module (e.g., the light output module **211** or the display **321**) to provide the virtual object (e.g., the first visual notification **610**, the second visual notification **620**, and/or the third visual notification **630**).

[0117] According to an embodiment of the disclosure, the wearable device **200** may control the speaker module **245** to provide the sound notification **640**. According to an embodiment of the disclosure, the wearable device **200**, in the case of providing the sound notification **640**, may highlight (e.g., amplify a volume) and output a specific frequency band according to a type of at least one external object (e.g., the vehicle **510**, the animal **520**, and/or the falling object **530**) so as to emphasize a sound signal generated from the identified at least one external object (e.g., the vehicle **510**, the animal **520**, and/or the falling object **530**). For example, the wearable device **200** according to an embodiment of the disclosure may highlight and output a low frequency in the case of a specific external object (e.g., the vehicle **510**) and highlight and output a mid/high frequency in the case of a human voice. For example, frequency bands other than the highlighted one may be weakened (e.g., reduce a volume) and output.

[0118] According to an embodiment of the disclosure, the wearable device **200** (e.g., the electronic device **101** in FIG. **1**), in operation **430**, may identify movement (e.g., movement of the user **500** wearing the wearable device **200**) of the wearable device **200**, in which the wearable device **200** is rotating toward at least one external object (e.g., the vehicle **510**). According to an embodiment of the disclosure, the wearable device **200**, based on an image captured by the camera module (e.g., the second camera module **253**) and/or a direction of a sound signal acquired through the speaker module **245**, may identify a direction (e.g., a direction established in the first beam area **510***a*) of at least one external object (e.g., the vehicle **510**). According to an embodiment of the disclosure, the wearable device **200** may identify a rotation direction and/or a rotation angle of the wearable device **200** by using sensing data acquired by at least one sensor (e.g., a gyro sensor and/or acceleration sensor) included in the wearable device **200**. Alternatively, the wearable device **200** according to an embodiment of the disclosure may identify a rotation direction and/or a rotation angle of the wearable device **200**, based on a direction of a sound signal acquired by the microphone module. By using such information (e.g., the direction in which at least one external object (e.g., the vehicle **510**) is located, or the rotation direction and/or the rotation angle of the wearable device **200**), the wearable device **200** according to an embodiment of the disclosure may identify a direction in which the user **500** wearing the wearable device **200** has rotated (e.g., which external object is located in the direction in which the head has rotated).

[0119] According to an embodiment of the disclosure, the wearable device **200** (e.g., the electronic device **101** in FIG. **1**), in operation **440**, may highlight and output a notification (e.g., the first visual notification **610**, the sound notification **640**, and/or the tactile notification) with respect to at least one object (e.g., the vehicle **510**) while maintaining beamforming with respect to the at least one external object (e.g., the vehicle **510**). FIG. **7** is a view illustrating a function or operation of, in a case in which a user **500** wearing a wearable device **200** rotates (e.g., shifting of gaze) toward one (e.g., a vehicle **510**) of a plurality of external objects (e.g., the vehicle **510**, an animal **520**, and/or a falling object **530**), maintaining beamforming with respect to the one external object (e.g., the vehicle **510**) according to an embodiment of the disclosure. Referring to FIG. **7**, the wearable device **200** according to an embodiment of the disclosure, in the case of rotating (e.g., shifting of gaze) toward one external object (e.g., the vehicle **510**) of the a plurality of external objects (e.g., the vehicle **510**, the animal **520**, and/or the falling object **530**), may emphasize (e.g., extend the first beam area **510***a*) beamforming with respect to the one external object (e.g., the vehicle **510**). For example, according to an embodiment of the disclosure, beamforming with respect to the remaining objects (e.g., the animal **520** and/or the falling object **530**) may be weakened (e.g., reduce the second beam area **520***a* and the third beam area **530***a*) or may not perform beamforming. According to an embodiment of the disclosure, the wearable device **200** may emphasize (e.g., extend the first beam area **510***a*) beamforming or weaken (e.g., reduce the second beam area **520***a* and the third beam area **530***a*) by adding or excluding a microphone.

[0120] According to an embodiment of the disclosure, the wearable device **200**, based on a level of risk, may highlight and output a notification (e.g., the first visual notification **610**, the sound notification **640**, and/or the tactile notification) with respect to at least one object (e.g., the vehicle **510**). According to an embodiment of the disclosure, the wearable device **200** may output a notification with respect to at least one object (e.g., the vehicle **510** and/or the falling object **530**) having relatively high risk to be more highlighted than at least one object (e.g., the animal **520**) having relatively low risk. The level of risk according to an embodiment of the disclosure may have been designated according to at least one object for each level. The function or operation of maintaining beamforming according to the rotation of the wearable device **200** according to an embodiment of the disclosure will be described in detail with reference to FIGS. **9** to **12**C.

[0121] FIG. **8**A is a view illustrating a function or operation of highlighting a notification (e.g., the first visual notification **610** and/or the sound notification **640**) with respect to one external object (e.g., the vehicle **510**) and providing same to a user according to an embodiment of the disclosure. FIGS. **8**B and **8**C are views illustrating various types of notifications with respect to a plurality of external objects (e.g., the vehicle **510**, the animal **520**, and/or the falling object **530**) according to an embodiment of the disclosure. Referring to FIG. **8**A, the wearable device **200** according to an embodiment of the disclosure, in a case in which rotation with respect to one object (e.g., the vehicle **510**) is identified, may enlarge the size of the provided notification (e.g., the first visual notification **610**) and provided the notification to the user **500** as a virtual object in the manner of augmented reality or virtual reality. For example, notifications (e.g., the second visual notification **620** and/or the third visual notification **630**) corresponding to the remaining external objects (e.g., the animal **520** and/or the falling object **530**) may not be provided as virtual objects, or may be provided at a reduced size from the size illustrated before the rotation of the wearable device **200** was identified. According to an embodiment of the disclosure, the wearable device **200**, in a case in which rotation with respect to one object (e.g., the vehicle **510**) has been identified, may output the sound notification **640** corresponding to the one object (e.g., the vehicle **510**) by increasing a volume thereof to be greater than the volume output before the rotation of the wearable device **200** was identified. For example, the sound notification **640** corresponding to the remaining external objects (e.g., the animal **520** and/or the falling object **530**) may not be provided, or may be provided at a reduced volume from the volume output before the rotation of the wearable device **200** was identified. According to an embodiment of the disclosure, the wearable device **200**, in a case in which rotation with respect to one object (e.g., the vehicle **510**) has been identified, may output the tactile notification by increasing a strength thereof to be greater than the strength of the tactile notification output before the rotation of the wearable device **200** was identified.

[0122] The notification (e.g., the visual notification) according to an embodiment of the disclosure may be provided in a form corresponding to external objects. Referring to FIGS. **8**B and **8**C, the visual notification according to an embodiment of the disclosure may include an image captured by the camera module (e.g., the second camera module **253**) as a virtual object illustrated to the user **500**. For example, the wearable device **200** according to an embodiment of the disclosure may provide an image having a first field of view (e.g., a relatively narrow field of view) as a virtual object and an image having a second field of view (e.g., a field of view wider than the first field of view) as a virtual object. An image captured by the camera module (e.g., the second camera module **253**) according to an embodiment of the disclosure may include an image corresponding to at least one external object (e.g., the vehicle **510** and/or the animal **520**).

[0123] With respect to FIG. **4**, for convenience of explanation, it is illustrated when the wearable device **200** rotates toward a one external object (e.g., the vehicle **510**), but the description with respect to FIG. **4** may equally apply when the wearable device **200** rotates toward a plurality of external objects.

[0124] FIG. **9** is a view illustrating a function or operation of, in a case in which a user wearing a wearable device **200** rotates (e.g., shifting of gaze) toward one (e.g., the vehicle **510**) of a plurality of external objects (e.g., the vehicle **510**, the animal **520**, and/or the falling object **530**), changing at least some of microphones (e.g., the first microphone **247***a*, the second microphone **247***b*, and/or the third microphone **247***c*) which are performing beamforming to another microphone (e.g., the third microphone **247***c*, the fourth microphone **247***d*, the fifth microphone **247***e*, the sixth microphone **247***f*, and/or the seventh microphone **247***g*) so as to maintain beamforming with respect to one object (e.g., the vehicle **510**) according to an embodiment of the disclosure.

[0125] Referring to FIG. **9**, the wearable device **200** according to an embodiment of the disclosure, in operation **910**, may identify rotation movement of the wearable device **200**. According to an embodiment of the disclosure, the wearable device **200**, based on an image captured by the camera module (e.g., the second camera module **253**) and/or a direction of a sound signal acquired through the speaker module **245**, may identify a direction (e.g., a direction established in the first beam area **510***a*) of at least one external object (e.g., the vehicle **510**). According to an embodiment of the disclosure, the wearable device **200** may identify a rotation direction and/or a rotation angle of the wearable device **200** by using sensing data acquired by at least one sensor (e.g., a gyro sensor and/or acceleration sensor) included in the wearable device **200**. Alternatively, the wearable device **200** according to an embodiment of the disclosure may identify a rotation direction and/or a rotation angle of the wearable device **200**, based on a direction of a sound signal acquired by the microphone module. By using such information (e.g., the direction in which at least one external object (e.g., the vehicle **510**) is located, or the rotation direction and/or the rotation angle of the wearable device **200**), the wearable device **200** according to an embodiment of the disclosure may identify a direction in which the user **500** wearing the wearable device **200** has rotated (e.g., which external object is located in the direction in which the head has rotated).

[0126] According to an embodiment of the disclosure, the wearable device **200**, in operation **920**, may select at least one microphone which maintains a direction of beamforming. FIG. **10** is a view illustrating a function or operation of performing beamforming with respect to a specific external object (e.g., the vehicle **510**) by using some (e.g., the first microphone **247***a*, the second microphone **247***b*, and/or the third microphone **247***c*) of a plurality of microphones (e.g., the first microphone **247***a*, the second microphone **247***b*, the third microphone **247***c*, the fourth microphone **247***d*, the fifth microphone **247***e*, the sixth microphone **247***f*, the seventh microphone **247***g*, the eighth microphone **247***h*, and/or the ninth microphone **247***i*) according to an embodiment of the disclosure. FIG. **11** is a view illustrating a function or operation of, in a case in which a user **500** wearing a wearable device **200** rotates by a specific angle (e.g., **0**), changing at least some of microphones (e.g., the first microphone **247***a*, the second microphone **247***b*, and/or the third microphone **247***c*) which are performing beamforming to other microphones (e.g., the third microphone **247***c*, the fourth microphone **247***d*, the fifth microphone **247***e*, the sixth microphone **247***f*, and/or the seventh microphone **247***g*) so as to maintain beamforming being performed with respect to a specific external object (e.g., the vehicle **510**) according to an embodiment of the disclosure. FIGS. **12**A to **12**C are views illustrating a function or operation of, in a case in which a user **500** wearing a wearable device **200** rotates by a specific angle (e.g., **0**), maintaining directivity of a beam according to an embodiment of the disclosure.

[0127] Referring to FIGS. **10** and **11**, the wearable device **200** according to an embodiment of the disclosure may perform beamforming with respect to at least one external object (e.g., the vehicle **510**). According to an embodiment of the disclosure, the at least one external object is located at the left rear side of the user **500**, and thus the wearable device **200** may perform beamforming toward the left rear side by using a plurality of microphones (e.g., the first microphone **247***a*, the second microphone **247***b*, and/or the third microphone **247***c*) located at the left side. In FIG. **10**, it is illustrated that a beam area **1010** (e.g., the first beam area **510***a*) is established at the left rear side according to the beamforming with respect to the at least one object (e.g., when the beam area **1010** is established at an angle of θ relative to when the user **500** is facing forward). According to an embodiment of the disclosure, the wearable device **200** may control the remaining microphones (e.g., the third microphone **247***c*, the fourth microphone **247***d*, the fifth microphone **247***e*, the sixth microphone **247***f*, the seventh microphone **247***g*, the eighth microphone **247***h*, and/or the ninth microphone **247***i*) not performing the beamforming to operate at low power or turn (e.g., deactivate) the remaining microphones off. According to an embodiment of the disclosure, the wearable device **200** may control (e.g., reduce) a voltage or clock applied to the remaining microphones (e.g., the third microphone **247***c*, the fourth microphone **247***d*, the fifth microphone **247***e*, the sixth microphone **247***f*, the seventh microphone **247***g*, the eighth microphone **247***h*, and/or the ninth microphone **247***i*) not performing the beamforming to cause the remaining microphones to operate at low power or to be deactivated. According to an embodiment of the disclosure, the wearable device **200** may control an operation voltage input to at least one microphone to control an operation of the at least one microphone. According to an embodiment of the disclosure, the wearable device **200** may control an input clock input to at least one microphone to control an operation of the at least one microphone. According to an embodiment of the disclosure, the wearable device **200** may control an operation of at least one microphone based on a control signal transmitted to the at least one microphone from an external device.

[0128] Referring to FIG. **11**, the wearable device **200** according to an embodiment of the disclosure, in a case in which the user **500** rotates (e.g., shifting of gaze) to the left rear side (e.g., in a case of rotating by an angle of θ relative to when the wearable device **200** and/or the user **500** is facing forward), may compensate for the rotated angle and select at least one microphone to perform beamforming. According to an embodiment of the disclosure, the wearable device **200** may maintain the performance of beamforming by using at least one microphone disposed at an angle of θ relative to when the user **500** is facing forward and at least one microphone disposed in a periphery of the microphone disposed at an angle of θ relative to when the user **500** is facing forward. According to an embodiment of the disclosure, in order to acquire information regarding an angle (e.g., θ), the wearable device **200** according to an embodiment of the disclosure may identify (e.g., calculate) a direction in which the beamforming is established and the angle configured by each of the microphones, based on when the user **500** is facing forward. According to an embodiment of the disclosure, the wearable device **200** may select at least one microphone to maintain the beamforming based on the identified angle (e.g., θ) so as to compensate for a rotation angle according to the rotation of the user **500**. According to an embodiment of the disclosure, the number of at least one microphone (e.g., the third microphone **247***c*, the fourth microphone **247***d*, the sixth microphone **247***f*, and/or the seventh microphone **247***g*) disposed in the periphery of the microphone (e.g., the fifth microphone **247***e*) disposed at an angle of θ relative to when the user **500** is facing forward may be designated or determined by selection of the user **500**.

[0129] Referring to FIG. **12**A, the wearable device **200** according to an embodiment of the disclosure may perform the beamforming in the left direction relative to a state where the user **500** is facing forward. According to an embodiment of the disclosure, θ**1** in FIG. **12**A may be substantially 90°. The wearable device **200** according to an embodiment of the disclosure may perform the beamforming in the left direction relative to a state where the user **500** is facing forward by using the third microphone **247***c* and the sixth microphone **247***f*. For example, the third microphone **247***c* and the sixth microphone **247***f* according to an embodiment of the disclosure may be operated at full power performance, while the other remaining microphones may be operated at lower power or deactivated (e.g., turned off). According to an embodiment of the disclosure, the wearable device **200** may identify (e.g., calculate) an angle configured by the direction of the established beam area **1010** and each microphone (e.g., the fifth microphone **247***e*). For example, the wearable device **200** according to an embodiment of the disclosure, as illustrated in FIG. **12**A, may identify that the angle configured by the direction of the established beam area **1010** and a specific microphone (e.g., the fifth microphone **247***e*) is θ**2** (e.g., 20°).

[0130] Referring to FIG. **12**B, according to an embodiment of the disclosure, the wearable device **200**, in a case in which the user **500** has rotated substantially (e.g., including a designated error range) by an angle of θ**2** (e.g., 20°), may change a microphone being used by the wearable device **200** for performing the beamforming to maintain the beamforming in the left direction. For example, the wearable device **200** according to an embodiment of the disclosure may change a microphone being used by the wearable device **200** for performing the beamforming from the sixth microphone **247***f* to the fifth microphone **247***e* to perform the beamforming. According to an embodiment of the disclosure, the wearable device **200** may selectively perform the beamforming using all of the third microphone **247***c*, the fifth microphone **247***e*, and the sixth microphone **247***f*. Referring to FIG. **12**C, according to an embodiment of the disclosure, the wearable device **200**, in a case in which the user **500** has rotated substantially (e.g., including a designated error range) by

90°, may change (e.g., add) a microphone being used by the wearable device **200** for performing the beamforming to maintain the beamforming in the left direction. For example, the wearable device **200** according to an embodiment of the disclosure may perform the beamforming by using the first microphone **247***a*, the third microphone **247***c*, the fourth microphone **247***d*, and the sixth microphone **247***f* to maintain the beamforming in the left direction. According to an embodiment of the disclosure, the wearable device **200** may selectively perform the beamforming using all of the first microphone **247***a*, the second microphone **247***b*, the third microphone **247***c*, the fourth microphone **247***d*, the fifth microphone **247***e*, and the sixth microphone **247***f*.
[0131] According to an embodiment of the disclosure, the wearable device **200**, in operation **930**, may perform the beamforming through the at least one microphone selected according to operation **920**. For example, the wearable device **200** according to an embodiment of the disclosure, in a case in which the user **500** has rotated substantially (e.g., including a designated error range) by an angle of θ**2** (e.g., 20°), may change a microphone being used by the wearable device **200** for performing the beamforming from the sixth microphone **247***f* to the fifth microphone **247***e* to perform the beamforming. As such, the rotation movement of the user **500** may be compensated for by a function or operation of the disclosure, such that the direction in which the beamforming is performed is maintained despite the rotation of the user **500** (e.g., shifting of gaze).
[0132] FIG. **13** is a view illustrating a function or operation of, in a case in which a user **500** wearing a wearable device **200** rotates (e.g., shifting of gaze) toward a specific external object (e.g., a vehicle), switching to a video see through (VST) mode according to an embodiment of the disclosure.
[0133] Referring to FIG. **13**, the wearable device **200** (e.g., the electronic device **101** in FIG. **1**) according to an embodiment of the disclosure, in operation **1310**, may perform beamforming with respect to at least one external object (e.g., the vehicle **510**, the animal **520**, or the falling object **530**) located around the user **500** wearing the wearable device **200** by using at least one microphone (e.g., the first microphone **247***a* and the second microphone **247***b*) among a plurality of microphones (e.g., the microphone module **247**).
[0134] According to an embodiment of the disclosure, the wearable device **200** (e.g., the electronic device **101** in FIG. **1**), in operation **1320**, may output a notification corresponding to at least one external object (e.g., the vehicle **510**, the animal **520**, and/or the falling object **530**).
[0135] According to an embodiment of the disclosure, the wearable device **200** (e.g., the electronic device **101** in FIG. **1**), in operation **1330**, may identify movement of the user **500** rotating toward at least one external object (e.g., the vehicle **510**). According to an embodiment of the disclosure, the wearable device **200**, based on an image captured by the camera module (e.g., the second camera module **253**) and/or a direction of a sound signal acquired through the speaker module **245**, may identify a direction (e.g., a direction established in the first beam area **510***a*) of at least one external object (e.g., the vehicle **510**). According to an embodiment of the disclosure, the wearable device **200** may identify a rotation direction and/or a rotation angle of the wearable device **200** by using sensing data acquired by at least one sensor (e.g., a gyro sensor and/or acceleration sensor) included in the wearable device **200**. Alternatively, the wearable device **200** according to an embodiment of the disclosure may identify a rotation direction and/or a rotation angle of the wearable device **200**, based on a direction of a sound signal acquired by the microphone module. By using such information (e.g., the direction in which at least one external object (e.g., the vehicle **510**) is located, or the rotation direction and/or the rotation angle of the wearable device **200**), the wearable device **200** according to an embodiment of the disclosure may identify a direction in which the user **500** wearing the wearable device **200** has rotated (e.g., which external object is located in the direction in which the head has rotated).
[0136] According to an embodiment of the disclosure, the wearable device **200** (e.g., the electronic device **101** in FIG. **1**), in operation **1430**, may provide information of a periphery of the user **500** wearing the wearable device **200** through a video see through (VST) mode. According to an

embodiment of the disclosure, the wearable device **200** may provide information of an image of the periphery of the user **500** captured by the camera module (e.g., the camera modules **311** and **312**) through the display (e.g., the display **321**) while highlighting beamforming with respect to a specific external object (e.g., the vehicle **510**). According to an embodiment of the disclosure, the VST mode may indicate a mode configured to provide information of an image of the periphery of the user **500** captured by the camera module (e.g., the camera modules **311** and **312**) through the display (e.g., the display **321**). Such function or operation may allow the user **500** to be intuitively informed of the surroundings of the user.

[0137] FIG. **14** is a view illustrating a function or operation of determining a type of a notification, based on whether a sound signal generated from an external object (e.g., an ambulance) located around a user **500** wearing a wearable device **200** is a sound signal included in a designated risk group, and providing the notification to the user according to the determined type of the notification according to an embodiment of the disclosure. FIGS. **15**A and **15**B are views illustrating a type 1 notification **1510** and a type 2 notification **1520** according to an embodiment of the disclosure.

[0138] In the descriptions of the operations herein, the operations may be performed in a different order than the order shown and/or described, or the operations may be performed in different orders or at different times. Certain operations may also be left out of, one or more operations may be repeated, or other operations may be added.

[0139] Referring to FIG. **14**, the wearable device **200** (e.g., the electronic device **101** in FIG. **1**) according to an embodiment of the disclosure, in operation **1410**, may perform beamforming with respect to at least one external object (e.g., the vehicle **510**, an animal **520**, or a falling object **530**) located around the user **500** wearing the wearable device **200** by using at least one microphone (e.g., a first microphone **247***a* and a second microphone **247***b*) among a plurality of microphones (e.g., the microphone module **247**).

[0140] According to an embodiment of the disclosure, the wearable device **200** (e.g., the electronic device **101** in FIG. **1**), in operation **1420**, may determine whether the sound signal generated from at least one external object (e.g., the vehicle **510**, the animal **520**, and the falling object **530**) is a sound signal of a high-risk group. According to an embodiment of the disclosure, the signal included in the high-risk group may be designated by the user or have been designated. For example, the wearable device **200** according to an embodiment of the disclosure may select, on a user interface provided through the wearable device **200**, a type of a sound signal included in the high-risk group or a type of at least one external object (e.g., the vehicle **510** or the ambulance). According to an embodiment of the disclosure, the wearable device **200** may compare a sound signal generated from at least one external object (e.g., the vehicle **510**, the animal **520**, and the falling object **530**) with a sound signal stored in the wearable device **200** that is configured to be included in the high-risk group. According to an embodiment of the disclosure, the wearable device **200** may determine, based on a result of the comparison, whether the sound signal generated from at least one external object (e.g., the vehicle **510**, the animal **520**, and the falling object **530**) is a sound signal included in the high-risk group.

[0141] According to an embodiment of the disclosure, the wearable device **200** (e.g., the electronic device **101** in FIG. **1**), in operation **1430**, in a case in which the wearable device **200** has determined that the sound signal generated from at least one external object (e.g., the vehicle **510**, the animal **520**, and the falling object **530**) is a sound signal included in the high-risk group (e.g., operation **1420**—Yes), may output a notification in a type 1 notification scheme. The type 1 notification scheme according to an embodiment of the disclosure may be a notification scheme having a size greater than that of a visual notification of a type 2 notification scheme (e.g., a representation scheme of a visual notification illustrated in FIG. **15**B), or a volume greater than that of an sound notification of the type 2 notification scheme, or a strength greater than that of a tactile notification of the type 2 notification scheme, as illustrated in FIG. **15**A.

[0142] According to an embodiment of the disclosure, the wearable device **200** (e.g., the electronic device **101** in FIG. **1**), in operation **1430**, in a case in which it is determined that the sound signal generated from at least one external object (e.g., the vehicle **510**, the animal **520**, and the falling object **530**) is a sound signal not included in the high-risk group (e.g., operation **1420**—No), may output a notification in the type 2 notification scheme. The type 2 notification scheme according to an embodiment of the disclosure may be a notification scheme having a size smaller than that of the visual notification of the type 1 notification scheme (e.g., a representation scheme of the visual notification illustrated in FIG. **15**A), or a volume smaller than that of the sound notification of the type 2 notification scheme, or a strength smaller than that of the tactile notification of the type 1 notification scheme, as illustrated in FIG. **15**B.
[0143] The function or operation according to the embodiment of the disclosure illustrated in FIG. **14** may be performed in association with FIG. **4**. For example, the wearable device **200** according to an embodiment of the disclosure, in a case in which the at least one external object (e.g., the vehicle **510**) is an ambulance, may control the wearable device **200** to change an attribute of the notification (e.g., increase the size of the visual notification) to be provided to the user **500**.
[0144] FIG. **16** is a view illustrating a function or operation of, in a case in which at least one external object (e.g., the vehicle **510**) is identified when a wearable device **200** and an external electronic device are operatively connected, outputting a content sound together with a sound generated from the at least one external object (e.g., the vehicle **510**) through the external electronic device according to an embodiment of the disclosure.
[0145] Referring to FIG. **16**, the wearable device **200** according to an embodiment of the disclosure, in operation **1610**, may control the external electronic device to output a content sound according to a first mode (e.g., a noise-canceling mode).
[0146] According to an embodiment of the disclosure, the wearable device **200**, in operation **1620**, may identify at least one object (e.g., the vehicle **510**). The wearable device **200** according to an embodiment of the disclosure may identify at least one external object (e.g., the vehicle **510**, the animal **520**, and/or the falling object **530**) located around the user **500** wearing the wearable device **200** by analyzing (e.g., comparing a shape of an external object with a shape stored in the wearable device **200**) an image captured by at least one camera (e.g., the second camera module **253**) capable of capturing a periphery of the user **500** wearing the wearable device **200**. According to an embodiment of the disclosure, the wearable device **200**, based on a sound signal generated from at least one external object (e.g., the vehicle **510**, the animal **520**, and/or the falling object **530**), may identify at least one external object (e.g., the vehicle **510**, the animal **520**, and/or the falling object **530**) (e.g., determine at least one external object as an object on which beamforming is to be performed).
[0147] According to an embodiment of the disclosure, the wearable device **200**, in operation **1630**, in a case in which the at least one external object (e.g., the vehicle **510**) is identified, may control the external electronic device to output a sound signal corresponding to the at least one external object (e.g., the vehicle **510**) together with a sound signal corresponding to the content through the external electronic device. According to an embodiment of the disclosure, the wearable device **200** may transmit, to the external electronic device, information for the sound signal corresponding to the at least one external object (e.g., the vehicle **510**) such that the sound signal (e.g., the sound signal generated from the at least one external object (e.g., the vehicle **510**)) corresponding to the at least one external object (e.g., the vehicle **510**) is output through the external electronic device. According to an embodiment of the disclosure, the wearable device **200** may output a pre-stored sound signal corresponding to at least one object together with a sound signal corresponding to the content, together with the sound corresponding to the at least one external object (e.g., the vehicle (**510**)) or instead of the sound corresponding to the at least one external object (e.g., the vehicle (**510**)).
[0148] In accordance with the function or operation of an embodiment of the disclosure, the user

500 may be able to facilitate the identification of access to a risk factor, even while listening to content sounds (e.g., music) through the external electronic device.

[0149] A wearable device **200** according to an embodiment of the disclosure may include a plurality of microphones (e.g., a first microphone **247***a*, a second microphone **247***b*, a third microphone **247***c*, a fourth microphone **247***d*, a fifth microphone **247***e*, a sixth microphone **247***f*, a seventh microphone **247***g*, an eighth microphone **247***h*, and/or a ninth microphone **247***i*), a display module (e.g., the light output module **211**), at least one speaker (e.g., the speaker module **245**), and at least one processor (e.g., the processor **120**), wherein the at least one processor may be configured to perform beamforming with respect to at least one object located around a user wearing the wearable device, by using at least one microphone among the a plurality of microphones, output, based on performing the beamforming, a notification corresponding to the at least one object through the at least one speaker and/or the display module, identify movement of the user rotating to face an object among a plurality of objects, and highlight and output, based on identifying the movement, through the at least one speaker or the display module, the notification corresponding to the at least one object while maintaining the beamforming with respect to the at least one object.

[0150] The electronic device according to various embodiments may be one of various types of electronic devices. The electronic devices may include, for example, a portable communication device (e.g., a smartphone), a computer device, a portable multimedia device, a portable medical device, a camera, a wearable device, or a home appliance. According to an embodiment of the disclosure, the electronic devices are not limited to those described herein.

[0151] It should be appreciated that various embodiments of the present disclosure and the terms used therein are not intended to limit the technological features set forth herein to particular embodiments and include various changes, equivalents, or replacements for a corresponding embodiment. With regard to the description of the drawings, similar reference numerals may be used to refer to similar or related elements. It is to be understood that a singular form of a noun corresponding to an item may include one or more of the things, unless the relevant context clearly indicates otherwise. As used herein, each of such phrases as “A or B,” “at least one of A and B,” “at least one of A or B,” “A, B, or C,” “at least one of A, B, and C,” and “at least one of A, B, or C,” may include any one of, or all possible combinations of the items enumerated together in a corresponding one of the phrases. As used herein, such terms as “1st” and “2nd,” or “first” and “second” may be used to simply distinguish a corresponding component from another, and does not limit the components in other aspect (e.g., importance or order). It is to be understood that if an element (e.g., a first element) is referred to, with or without the term “operatively” or “communicatively”, as “coupled with,” “coupled to,” “connected with,” or “connected to” another element (e.g., a second element), it means that the element may be coupled with the other element directly (e.g., wiredly), wirelessly, or via a third element.

[0152] As used in connection with various embodiments of the disclosure, the term “module” may include a unit implemented in hardware, software, or firmware, and may interchangeably be used with other terms, for example, “logic,” “logic block,” “part,” or “circuitry”. A module may be a single integral component, or a minimum unit or part thereof, adapted to perform one or more functions. For example, according to an embodiment, the module may be implemented in a form of an application-specific integrated circuit (ASIC).

[0153] The term “substantially,” as used herein, means approximately or actually. The term “substantially equal” means approximately or actually equal. The term “substantially the same” means approximately or actually the same. The term “substantially perpendicular” means approximately or actually perpendicular. The term “substantially parallel” means approximately or actually parallel.

[0154] Various embodiments as set forth herein may be implemented as software (e.g., the program **2540**) including one or more instructions that are stored in a storage medium (e.g., internal memory

2536 or external memory **2538**) that is readable by a machine (e.g., the electronic device **2501**). For example, a processor (e.g., the processor **2520**) of the machine (e.g., the electronic device **2501**) may invoke at least one of the one or more instructions stored in the storage medium, and execute it, with or without using one or more other components under the control of the processor. This allows the machine to be operated to perform at least one function according to the at least one instruction invoked. The one or more instructions may include a code generated by a complier or a code executable by an interpreter. The machine-readable storage medium may be provided in the form of a non-transitory storage medium. Wherein, the term “non-transitory” simply means that the storage medium is a tangible device, and does not include a signal (e.g., an electromagnetic wave), but this term does not differentiate between where data is semi-permanently stored in the storage medium and where the data is temporarily stored in the storage medium.
[0155] According to an embodiment, a method according to various embodiments of the disclosure may be included and provided in a computer program product. The computer program product may be traded as a product between a seller and a buyer. The computer program product may be distributed in the form of a machine-readable storage medium (e.g., compact disc read only memory (CD-ROM)), or be distributed (e.g., downloaded or uploaded) online via an application store (e.g., PlayStore™), or between two user devices (e.g., smart phones) directly. If distributed online, at least part of the computer program product may be temporarily generated or at least temporarily stored in the machine-readable storage medium, such as memory of the manufacturer's server, a server of the application store, or a relay server.
[0156] According to various embodiments, each component (e.g., a module or a program) of the above-described components may include a single entity or multiple entities, and some of the multiple entities may be separately disposed in different components. According to various embodiments, one or more of the above-described components may be omitted, or one or more other components may be added. Alternatively or additionally, a plurality of components (e.g., modules or programs) may be integrated into a single component. In such a case, according to various embodiments, the integrated component may still perform one or more functions of each of the plurality of components in the same or similar manner as they are performed by a corresponding one of the plurality of components before the integration. According to various embodiments, operations performed by the module, the program, or another component may be carried out sequentially, in parallel, repeatedly, or heuristically, or one or more of the operations may be executed in a different order or omitted, or one or more other operations may be added.

Claims

1. A wearable device comprising: a plurality of microphones; a display module; at least one speaker; at least one processor; and memory storing instructions that, when executed by the at least one processor individually or collectively, cause the wearable device to: perform, by using at least one microphone among the plurality of microphones, beamforming with respect to a plurality of objects located around the wearable device; based on the performing of the beamforming, output a notification corresponding to the plurality of objects through at least one of the at least one speaker or the display module; identify movement of the wearable device in which the wearable device is rotating to face an object among the plurality of objects; and based on the identifying of the movement, highlight and output the notification corresponding to the object through at least one of the at least one speaker or the display module while maintaining the beamforming with respect to the plurality of objects.
2. The wearable device of claim 1, further comprising at least one camera, wherein the instructions cause the wearable device to, based on an image captured by the at least one camera and a sound obtained by the plurality of microphones, identify whether the plurality of objects is located around the wearable device.

3. The wearable device of claim 1, wherein the instructions cause the wearable device to, in a case in which the movement of the wearable device is identified, perform beamforming by using at least one other microphone different from the at least one microphone being used for performing the beamforming.
4. The wearable device of claim 1, wherein the instructions cause the wearable device to control one or more remaining microphones other than the at least one microphone among the plurality of microphones such that the one or more remaining microphones are: operated at low power, minimized performance, or both; or deactivated.
5. The wearable device of claim 1, wherein the instructions cause the wearable device to, in a case in which the movement of the wearable device is identified, increase a volume of the notification output through the at least one speaker or output a designated sound effect.
6. The wearable device of claim 1, wherein the instructions cause the wearable device to, in a case in which the movement of the wearable device is identified, control the display module such that a size of the notification is changed based on a level of risk is output through the display module.
7. The wearable device of claim 1, wherein the instructions cause the wearable device to control the display module such that a virtual object corresponding to shapes of the plurality of objects are output through the display module.
8. The wearable device of claim 1, wherein the instructions cause the wearable device to, in a case in which the movement of the wearable device is identified, control at least one camera comprised in the wearable device such that the wearable device is operated in a video see through (VST) mode which directly shows an external environment.
9. The wearable device of claim 1, wherein the instructions cause the wearable device to: determine whether a sound generated from the object is a sound belonging to a configured high-risk group; and in a case in which the wearable device determines that the sound generated from the object is a sound belonging to the configured high-risk group, control the at least one speaker or the display module such that the notification output through the at least one speaker is output at a volume greater than or equal to a designated magnitude or the notification output through the display module is output at a size greater than or equal to a designated size.
10. The wearable device of claim 1, wherein the instructions cause the wearable device to, in a case in which the plurality of objects are identified, control an external electronic device operatively connected to the wearable device such that at least one of a sound generated from the plurality of objects or a prestored sound corresponding to the plurality of objects are output together with a content sound being output by the external electronic device.
11. A method for controlling a wearable device, the method comprising: performing, by using at least one microphone among a plurality of microphones of the wearable device, beamforming with respect to a plurality of objects located around the wearable device; based on the performing of the beamforming, outputting a notification corresponding to the plurality of objects through at least one of: at least one speaker of the wearable device; or a display module of the wearable device; identifying movement of the wearable device in which the wearable device is rotating to face an object among the plurality of objects; and based on the identifying of the movement, highlighting and outputting the notification corresponding to the object through at least one of the at least one speaker or the display module while maintaining the beamforming with respect to the plurality of objects.
12. The method of claim 11, wherein: the wearable device further comprises at least one camera, and the method further comprises, based on an image captured by the at least one camera and a sound obtained by the plurality of microphones, identifying whether the plurality of objects are located around the wearable device.
13. The method of claim 11, further comprising, in a case in which the movement of the wearable device is identified, performing beamforming by using at least one other microphone different from the at least one microphone being used for performing the beamforming.

14. The method of claim 11, further comprising controlling one or more remaining microphones other than the at least one microphone among the plurality of microphones such that the one or more remaining microphones are: operated at low power, minimized performance, or both; or deactivated.

15. The method of claim 11, further comprising, in a case in which the movement of the wearable device is identified, outputting the notification with a volume changed according to a level of risk through the at least one speaker.

16. One or more non-transitory computer-readable storage media storing one or more computer programs including computer-executable instructions that, when executed by one or more processors of a wearable device individually or collectively, the wearable device cause the wearable device to perform operations, the operations comprising: performing, by using at least one microphone among a plurality of microphones of the wearable device, beamforming with respect to a plurality of objects located around the wearable device; based on the performing of the beamforming, outputting a notification corresponding to the plurality of objects through at least one of: at least one speaker of the wearable device; or a display module of the wearable device; identifying movement of the wearable device in which the wearable device is rotating to face an object among the plurality of objects; and based on the identifying of the movement, highlighting and outputting the notification corresponding to the object through at least one of the at least one speaker or the display module while maintaining the beamforming with respect to the plurality of objects.

17. The one or more non-transitory computer-readable storage media of claim 16, wherein the operations further comprising: in a case in which the movement of the wearable device is identified, increasing a volume of the notification output through the at least one speaker or output a designated sound effect.

18. The one or more non-transitory computer-readable storage media of claim 16, wherein the operations further comprising: in a case in which the movement of the wearable device is identified, performing beamforming by using at least one other microphone different from the at least one microphone being used for performing the beamforming.

19. The one or more non-transitory computer-readable storage media of claim 16, wherein the operations further comprising: controlling one or more remaining microphones other than the at least one microphone among the plurality of microphones such that the one or more remaining microphones are: operated at low power, minimized performance, or both; or deactivated.

20. The one or more non-transitory computer-readable storage media of claim 16, wherein the operations further comprising: in a case in which the movement of the wearable device is identified, increasing a volume of the notification output through the at least one speaker or output a designated sound effect.