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ELECTRONIC DEVICE COMPRISING PIEZOELECTRIC DEVICE, AND TOUCH INPUT DETECTION METHOD USING PIEZOELECTRIC DEVICE

Abstract

At least one processor, individually and/or collectively, of an electronic device, according to various embodiments of the present disclosure, may be configured to: if communicatively connected to an external electronic device through a short-range communication circuit in a state where a piezoelectric element and an audio output circuit are electrically connected, control at least one switching circuit so that the piezoelectric element and a touch sensing circuit are electrically connected; if a touch input is detected in the piezoelectric element through the touch sensing circuit, control the at least one switching circuit so that the piezoelectric element and the audio output circuit are electrically connected, and output audio through the audio output circuit; and after outputting the audio, control the at least one switching circuit so that the piezoelectric element and the touch sensing circuit are electrically connected.

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Background/Summary

CROSS-REFERENCE TO RELATED APPLICATIONS [0001] This application is a continuation of International Application No. PCT/KR2023/014192 designating the United States, filed on Sep. 19, 2023, in the Korean Intellectual Property Receiving Office and claiming priority to Korean Patent Application Nos. 10-2022-0161803, filed on Nov. 28, 2022, and 10-2022-0169481, filed on Dec. 7, 2022, in the Korean Intellectual Property Office, the disclosures of each of which are incorporated by reference herein in their entireties.

BACKGROUND

Field

[0002] The disclosure relates to an electronic device including a piezoelectric element, and a method for detecting a touch input using the piezoelectric element.

Description of Related Art

[0003] In line with recent technical development, electronic devices have evolved from unilateral rectangular shapes to more diversified shapes. As an example, an electronic device may include a small-sized tag device. The tag device may be fabricated such that the same can be mounted on an object (for example, a bag or a bicycle). The tag device may communicate with an external electronic device while being mounted on the object. For example, the tag device may communicate with an external electronic device so as to transmit position information. The tag device may communicate with an external electronic device so as to transmit position information and, based on identifying a state of missing, may output a notification regarding the state of missing using a piezoelectric element included in the tag device. In addition to the above-described function, the tag device may include a touch key, and may control the function of the external electronic device having a communication connection thereto through an input using the touch key.

[0004] The above-described information may be provided as a related art for helping the understanding of the disclosure. No assertion or determination is made regarding whether any of the above description may be applied as a prior art related to the disclosure.

[0005] However, an electronic device such as a tag device needs to have a small size such that the same can be mounted on an object, but a touch key included therein may increase the volume of the electronic device, thereby degrading the usability in terms of portability.

SUMMARY

[0006] Embodiments of the disclosure may use a metal portion formed on a surface of a piezoelectric element included in the electronic device as a touch key. For example, the electronic device may include: a sound output circuit, a touch sensing circuit, and a switching circuit. The electronic device may control the switching circuit such that the piezoelectric element and the touch sensing circuit are electrically connected according to the situation of the electronic device, thereby detecting touch inputs made on the piezoelectric element through the touch sensing circuit, or may control the switching circuit such that the piezoelectric element and the sound output circuit

are electrically connected, thereby outputting sounds generated by vibrations of the piezoelectric element through the sound output circuits.

[0007] Embodiments of the disclosure may adjust the cycle at which touch inputs on the piezoelectric element are scanned through the touch sensing circuit, based on whether a touch input is detected through the touch sensing circuit, in a state in which the piezoelectric element and the touch sensing circuit are electrically connected.

[0008] An electronic device according to an example embodiment of the disclosure may include: a housing and a piezoelectric element comprising a piezoelectric material disposed to one surface of the housing in an inner space of the housing; a short-range communication circuit, a sound output circuit, and a touch sensing circuit. The electronic device according to an embodiment may include at least one switching circuit configured to control the electric connection between the piezoelectric element and the sound output circuit or the electric connection between the piezoelectric element and the touch sensing circuit. The electronic device according to an example embodiment may include at least one processor, comprising processing circuitry, operatively connected to the piezoelectric element, the short-range communication circuit, the sound output circuit, the touch sensing circuit, and the at least one switching circuit. In an example embodiment, at least one processor, individually and/or collectively, may be configured to: based on a communication connection to an external electronic device being established through the short-range communication circuit in a state in which the piezoelectric element and the sound output circuit are electrically connected, control the at least one switching circuit such that the piezoelectric element and the touch sensing circuit are electrically connected; based on a touch input being detected from the piezoelectric element through the touch sensing circuit, control the at least one switching circuit such that the piezoelectric element and the sound output circuit are electrically connected, and may output a sound through the sound output circuit; and control the at least one switching circuit such that the piezoelectric element and the touch sensing circuit are electrically connected, after outputting the sound.

[0009] A method for detecting a touch input using a piezoelectric element of an electronic device according to an example embodiment of the disclosure may include: based on a communication connection to an external electronic device being established through a short-range communication circuit in a state in which the piezoelectric element and a sound output circuit are electrically connected, controlling at least one switching circuit such that the piezoelectric element and a touch sensing circuit are electrically connected; based on a touch input being detected from the piezoelectric element through the touch sensing circuit, controlling the at least one switching circuit such that the piezoelectric element and the sound output circuit are electrically connected, and outputting a sound through the sound output circuit; and controlling the at least one switching circuit such that the piezoelectric element and the touch sensing circuit are electrically connected, after outputting the sound.

[0010] According to an example embodiment of the disclosure, a non-transitory computer-readable storage medium (or a computer program product) storing one or more programs may be provided. One or more programs according to an embodiment may include instructions which, when executed by at least one processor, comprising processing circuitry, individually and/or collectively, of an electronic device, cause the electronic device to: control at least one switching circuit such that a piezoelectric element and a touch sensing circuit are electrically connected based on a communication connection to an external electronic device being established through a short-range communication circuit in a state in which the piezoelectric element and a sound output circuit are electrically connected; control the at least one switching circuit such that the piezoelectric element and the sound output circuit are electrically connected based on a touch input being detected from the piezoelectric element through the touch sensing circuit, and output a sound through the sound output circuit; and control the at least one switching circuit such that the piezoelectric element and the touch sensing circuit are electrically connected, after outputting the sound.

[0011] An electronic device according to an example embodiment of the disclosure may control the switching circuit such that the piezoelectric element and the touch sensing circuit are electrically connected according to the situation of the electronic device, thereby detecting a touch input on the piezoelectric element through the touch sensing circuit, or may control the switching circuit such that the piezoelectric element and the sound output circuit are electrically connected and may output sounds generated by vibrations of the piezoelectric element through the sound output circuit, thereby performing a sound output function and a touch input detecting function through the piezoelectric element. The electronic device may have improved usability in terms of the portability of the electronic device and the functionality thereof as the electronic device can perform a sound output function and a touch input detecting function using the piezoelectric element.

[0012] An electronic device according to an example embodiment of the disclosure may adjust the cycle at which touch inputs on the piezoelectric element are scanned through the touch sensing circuit to be longer than a designated cycle in case that no touch input is detected through the touch sensing circuit in a state in which the piezoelectric element and the touch sensing circuit are electrically connected. The amount of current consumed by the touch input scanning operation may be reduced by adjusting the cycle at which touch inputs are scanned to be longer than the designated cycle in case that no touch input is detected through the touch sensing circuit.

Description

BRIEF DESCRIPTION OF THE DRAWINGS

[0013] The above and other aspects, features and advantages of certain embodiments of the present disclosure will be more apparent from the following detailed description, taken in conjunction with the accompanying drawings, in which:

[0014] FIG. **1** is a block diagram illustrating an example electronic device in a network environment according to various embodiments;

[0015] FIG. **2**A is a perspective view illustrating an example electronic device according to various embodiments;

[0016] FIG. **2**B is a cross-sectional view of the electronic device taken along line **2***b*-**2***b*′ in FIG. **2**A according to various embodiments;

[0017] FIG. **3** is a magnified sectional view of a partial area in the inner space of the electronic device in FIG. **2**B according to various embodiments;

[0018] FIG. **4** is a block diagram illustrating an example configuration electronic device according to various embodiments;

[0019] FIG. **5**A and FIG. **5**B are circuit diagrams illustrating a sound output circuit, a touch sensing circuit, and at least one switching circuit according to various embodiments;

[0020] FIG. **6** is a flowchart illustrating an example method for controlling the electric connection between a piezoelectric element and a sound output circuit or the electric connection between a piezoelectric element and a touch sensing circuit according to various embodiments;

[0021] FIG. **7** is a flowchart illustrating an example method for controlling the electric connection between a piezoelectric element and a sound output circuit or the electric connection between a piezoelectric element and a touch sensing circuit according to various embodiments;

[0022] FIG. **8** is a flowchart illustrating example operations in FIG. **6** and FIG. **7** according to various embodiments; and

[0023] FIG. **9** is a flowchart illustrating an example method for adjusting the touch input sensing cycle, based on whether a touch input using a piezoelectric element is detected or not, according to various embodiments.

DETAILED DESCRIPTION

[0024] Hereinafter, various example embodiments of the disclosure will be described in greater detail with reference to the drawings. However, the disclosure may be implemented in various different forms, is are not limited to the various example embodiments described herein. In relation to descriptions of the drawings, identical or similar components may be given identical or similar reference numerals. In addition, in the drawings and related descriptions, descriptions of widely known functions and components may be omitted for clarity and brevity.
[0025] FIG. **1** is a block diagram illustrating an example electronic device **101** in a network environment **100** according to various embodiments.
[0026] Referring to FIG. **1**, an electronic device **101** in a 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 connection 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 various embodiments, at least one of the components (e.g., the connection 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 various 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**).
[0027] The processor **120** may include various processing circuitry and/or multiple processors. For example, as used herein, including the claims, the term “processor” may include various processing circuitry, including at least one processor, wherein one or more of at least one processor, individually and/or collectively in a distributed manner, may be configured to perform various functions described herein. As used herein, when “a processor”, “at least one processor”, and “one or more processors” are described as being configured to perform numerous functions, these terms cover situations, for example and without limitation, in which one processor performs some of recited functions and another processor(s) performs other of recited functions, and also situations in which a single processor may perform all recited functions. Additionally, the at least one processor may include a combination of processors performing various of the recited/disclosed functions, e.g., in a distributed manner. At least one processor may execute program instructions to achieve or perform various functions. 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 an 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**. For example, when 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**.
[0028] 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.

[0029] 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**. The non-volatile memory **134** may include an internal memory **136** and/or an external memory **138**.

[0030] 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**.

[0031] 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).

[0032] 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.

[0033] 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.

[0034] 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**) (e.g., speaker or headphone) directly (e.g., wiredly) or wirelessly coupled with the electronic device **101**.

[0035] 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.

[0036] 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., through wires) 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.

[0037] The connection 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 connection terminal **178** may include, for example, an HDMI connector, a USB connector, an SD card connector, or an audio connector (e.g., a headphone connector).

[0038] 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.

[0039] 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.

[0040] The power management module **188** may manage power supplied to the electronic device **101**. According to an embodiment, the power management module **188** may be implemented as at least part of, for example, a power management integrated circuit (PMIC).

[0041] 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.

[0042] 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., an 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™, 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 fifth generation (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**.

[0043] 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.

[0044] 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 including 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**.

[0045] According to various embodiments, the antenna module **197** may form 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., an 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.

[0046] 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)).

[0047] 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 an 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.

[0048] FIG. **2**A perspective view illustrating an example electronic device **200** according to various embodiments. FIG. **2**B is a cross-sectional view of the electronic device **200** taken along line **2***b*-**2***b*′ in FIG. **2**A according to various embodiments.

[0049] The electronic device **200** in FIG. **2**A and FIG. **2**B according to various embodiments may be at least partially similar to the electronic device **101** in FIG. **1**, or may further include various embodiments of the electronic device.

[0050] The electronic device **200** according to various embodiments may include a small position tracking device (for example, a tag device) fabricated such that the same can be mounted on an object (for example, a bag or a bicycle).

[0051] Referring to FIG. **2**A, the electronic device **200** may include a housing **210** including a first surface **211**, a second surface **213** facing in the opposite direction of the first surface **211**, and/or a lateral surface **215** surrounding at least a part of the space **235** between the first surface **211** and the second surface **213**. In an embodiment (not illustrated), the housing **210** may refer to a structure that forms at least some of the first surface **211**, the second surface **213**, and the lateral surface **215**. In an embodiment, the housing **210** may be made of a plastic injection-molded material.

[0052] In an embodiment, the electronic device **200** may include a cover **220** disposed on the first surface **211** of the housing **210**. In an embodiment, the cover **220** may be attachable/detachable.

[0053] For example, reference numeral <**205**> in FIG. **2**A illustrates a state in which the cover **220** is attached, and reference numeral <**230**> in FIG. **2**A and FIG. **2**B illustrate a state in which the cover **220** is detached.

[0054] In an embodiment, a battery (for example, the battery **189** in FIG. **1** or the battery **325** in FIG. **3**), a printed circuit board (PCB) (for example, the PCB **320** in FIG. **3**), and/or a piezoelectric element **240** may be disposed in a partial area **300** in the inner space **235** of the housing **210**. However, the disclosure is not limited thereto.

[0055] The components disposed in the partial area **300** in the inner space **235** of the housing **210** according to various embodiments will be described in greater detail below with reference to FIG. **3**.

[0056] FIG. **3** is a magnified cross-sectional view of the partial area **300** in the inner space **235** of the electronic device **200** in FIG. **2**B according to various embodiments.

[0057] Referring to FIG. **3**, the electronic device (for example, the electronic device **200** in FIG. **2**A and FIG. **2**B) may include a housing (for example, the housing **210** in FIG. **2**A and FIG. **2**B) including a first surface (for example, the first surface **211** in FIG. **2**A and FIG. **2**B), a second surface (for example, the second surface **213** in FIG. **2**A and FIG. **2**B) facing in the opposite direction of the first surface **211**, and/or a lateral surface (for example, the lateral surface **215** in FIG. **2**A and FIG. **2**B) surrounding at least a part of the space **235** between the first surface **211** and the second surface **213**. In the inner space **235** of the housing **210**, a battery **325**, a printed circuit board **320**, and/or a piezoelectric element **240** may be included.

[0058] Referring to reference numeral <**310**> according to an embodiment, the electronic device **200** may include a printed circuit board **320** disposed in the inner space **235** of the housing **210**. On the printed circuit board **320**, a short-range communication circuit (for example, the

communication module **190** in FIG. **1**), a memory (for example, the memory **130** in FIG. **1**), a sound output circuit (for example, the sound output module **155** in FIG. **1**), a touch sensing circuit, a switching circuit, and/or a processor (for example, the processor **120** in FIG. **1**) may be disposed. However, the disclosure is not limited thereto, and a sensor circuit (for example, the sensor module **176** in FIG. **1**) may be further disposed on the printed circuit board **320**.

[0059] In an embodiment, a battery **325** (for example, the battery **189** in FIG. **1**) may be disposed on the upper portion (for example, direction {circle around (**2**)}) of the printed circuit board **320**. In an embodiment, the battery **325** is a device for supplying power to at least one component of the electronic device **200** and may include, for example, a primary cell which is not rechargeable, a secondary battery which is rechargeable, or a fuel cell. The battery **325** may be disposed such that the same can be attached to/detached from the electronic device **200**. The disclosure is not so limited, and the battery **325** may be integrally disposed inside the electronic device **200**.

[0060] In an embodiment, a piezoelectric element **240** may be included on the lower portion (for example, direction {circle around (**1**)}) of the printed circuit board **320**. In an embodiment, the piezoelectric element **240** may be made of ceramic and/or metal (for example, aluminum (Al), stainless steel (STS), zinc (Zn), and/or copper (Cu)).

[0061] In an embodiment, although not illustrated, the electronic device **200** may include a support plate disposed on the lower portion (for example, direction {circle around (**1**)}) of the battery **325**. The support plate (not illustrated) may be formed to have a material and a shape configured to support the battery **325**.

[0062] In an embodiment, the piezoelectric element **240** may have a circular shape. However, the disclosure is not limited thereto. In an embodiment, the piezoelectric element **240** may be disposed to one surface **311** of the inner space **235** corresponding to the second surface **213** of the housing **210**. In an embodiment, the piezoelectric element **240** may be attached to one surface **311** of the inner space **235** corresponding to the second surface **213** of the housing **210** through an attachment member. The attachment member may include a double-sided tape. However, the disclosure is not limited thereto. For example, a double-sided tape **315** may be attached to the edge of a surface (for example, a surface facing in direction {circle around (**1**)}) of the piezoelectric element **240**. Through the double-sided tape **315**, the piezoelectric element may be attached to at least a part of one surface **311** of the inner space **235** corresponding to the second surface **213** of the housing **210**.

[0063] In an embodiment, the double-sided tape **315** (attachment member) may play the role of a medium that transfers vibrations between the piezoelectric element **240** and the second surface **213** of the housing **210** made of a plastic material. In consideration thereof, the thickness of the second surface **213** of the housing **210** and the thickness of the piezoelectric element **240** may be determined to facilitate touch detection and/or vibration transfer. For example, the second surface **213** of the housing **210** may have a thickness of about 0.4 t, and the double-sided tape **315** may have a thickness of about 0.1 t. However, the disclosure is not limited thereto.

[0064] In an embodiment, the second surface **213** of the electronic device **200** may have a speaker hole **330** formed therein. For example, the speaker hole **330** may be used as an external speaker.

[0065] In an embodiment, the piezoelectric element **240** may be electrically connected to the sound output circuit or the touch sensing circuit under the control of the processor **120**. In an embodiment, in case that the piezoelectric element **240** is electrically connected to the sound output circuit, the processor **120** may cause the piezoelectric element **240** to vibrate through the sound output circuit and may output sounds through the speaker hole **330**. As another example, in case that the piezoelectric element **240** is electrically connected to the touch sensing circuit, the processor **120** may detect touch inputs on the piezoelectric element **240** through the touch sensing circuits.

[0066] Although it has been described in connection with reference numeral <**310**> according to various embodiments that a battery **325**, a printed circuit board **320**, and a piezoelectric element **240** are disposed in a stacking structure in the inner space **235** of the housing **210**, and that the

second surface **213** of the housing **210** has a speaker hole **330** formed therein, the disclosure is not limited thereto. This will be described later in connection with reference numeral <**350**>.
[0067] In connection with describing components illustrated in reference numeral <**350**>, components substantially identical to those described above with reference to reference numeral <**310**> are given identical reference numerals, and detailed descriptions thereof may not be repeated here.
[0068] Referring to reference numeral <**350**> according to an embodiment, the printed circuit board **320** may be may be substantially disposed on the same plane as the battery **325**.
[0069] In an embodiment, the piezoelectric element **240** may be attached to one surface **311** of the inner space **235** corresponding to the second surface **213** of the housing **210** through an attachment member. For example, the attachment member may include a double-sided tape. In an embodiment, a double-sided tape **315** may be attached to one surface (for example, a surface facing in direction {circle around (**1**)}) of the piezoelectric element **240**. Through the double-sided tape **315**, the piezoelectric element **240** may be attached to at least a part of one surface **311** of the inner space **235** corresponding to the second surface **213** of the housing **210**.
[0070] FIG. **4** is a block diagram **400** illustrating an example configuration of an electronic device **401** according to various embodiments.
[0071] Referring to FIG. **4**, the electronic device **401** (for example, the electronic device **101** in FIG. **1** or the electronic device **200** in FIG. **2**A to FIG. **3**) may include a short-range communication circuit **410** (for example, the communication module **190** in FIG. **1**), a memory **420** (for example, the memory **130** in FIG. **1**), a switching circuit **430**, a piezoelectric element (e.g., including a piezoelectric material) **440** (for example, the piezoelectric element **240** in FIG. **2**A and FIG. **3**), a sound output circuit **450** (for example, the sound output module **155** in FIG. **1**), a touch sensing circuit **460**, and/or a processor (e.g., including processing circuitry) **470** (for example, the processor **120** in FIG. **1**).
[0072] According to various embodiments, the short-range communication circuit **410** (for example, the communication module **190** in FIG. **1**) may establish a communication channel with an external electronic device (for example, the electronic device **102** or the sever **108** in FIG. **1**) and may support transmission/reception of various pieces of data with the external electronic device.
[0073] In an embodiment, the short-range communication circuit **410** may include, for example, and without limitation, at least one of Bluetooth, Bluetooth low energy (BLE), ultra-wideband (UWB), Wi-Fi, or the like.
[0074] According to various embodiments, the memory **420** (for example, the memory **130** in FIG. **1**) may store programs for processing and control of the processor **470** (for example, the program **140** in FIG. **1**), an operating system (OS) (for example, the OS **142** in FIG. **1**), various applications, and/or programs which perform input/output data storing functions, and which control overall operations of the electronic device **401**. The memory **420** may store various instructions that may be performed by the processor **470**.
[0075] In an embodiment, the memory **420** store instructions for controlling the switching circuit **430** such that the piezoelectric element **440** and the touch sensing circuit **460** are electrically connected, based on a communication connection established between an external electronic device and the short-range communication circuit **410**, under the control of the processor **470**. The memory **420** may store instructions for outputting sounds through the sound output circuit **450** by controlling the switching circuit **430** such that the piezoelectric element **440** and the sound output circuit **450** are electrically connected, in case that a touch input is detected through the touch sensing circuit **460**, under the control of the processor **470**. The memory **420** may store instructions for transmitting, if a touch input is detected through the touch sensing circuit **460**, a signal related to the detected touch input to an external electronic device under the control of the processor **470**.
[0076] In an embodiment, the memory **420** may store instructions for adjusting the cycle at which

touch inputs on the piezoelectric element **440** are scanned through the touch sensing circuit **460**, based on whether touch inputs are detected through the touch sensing circuit **460**, under the control of the processor **470**.

[0077] In an embodiment, the memory **420** may store instructions for controlling the switching circuit **430** such that the piezoelectric element **440** and the sound output circuit **450** are electrically connected, if the communication connection to the external electronic device is released, or if a signal related to sound output is received, under the control of the processor **470**. The memory **420** may store instructions for causing the electronic device **440** and thus outputting sounds through the sound output circuit **450**, if a signal related to sound output is received, under the control of the processor **470**.

[0078] According to various embodiments, the switching circuit **430** may electrically connect the piezoelectric element **440** and the sound output circuit **450** under the control of the processor **470**, or may electrically connect the piezoelectric element **440** and the touch sensing circuit **460**.

[0079] According to various embodiments, the piezoelectric element **440** (for example, the piezoelectric element **240** in FIG. **2**A and FIG. **3**) may be attached to one surface **311** of the inner space **235** corresponding to the second surface **213** of the housing **210** through an attachment member (for example, the attachment member **315** in FIG. **3**) in the inner space (for example, the inner space **235** in FIG. **2**A to FIG. **3**) of the housing **210** of the electronic device **401**.

[0080] In an embodiment, the piezoelectric element **440** may be used to output sounds in case that the same is electrically connected to the sound output circuit **450** under the control of the processor **470**.

[0081] In an embodiment, the piezoelectric element **440** may be used to detect touch inputs in case that the same is electrically connected to the touch sensing circuit **460** under the control of the processor **470**.

[0082] According to various embodiments, the sound output circuit **450** (for example, the sound output module **155** in FIG. **1**) may cause the piezoelectric element **440** to vibrate under the control of the processor **470**.

[0083] According to various embodiments, the touch sensing circuit **460** may detect a change in capacitance caused by a conductive object (for example, finger) that contacts the piezoelectric element **440**. The touch sensing circuit **460** may transfer information regarding the detected change in capacitance to the processor **470**.

[0084] According to various embodiments, the processor **470** may include various processing circuitry, including, for example, a micro controller unit (MCU), for example, and may drive the OS or embedded software program so as to control multiple hardware components connected to the processor **470**. The processor **470** may control multiple hardware components according to instructions (for example, the program **140** in FIG. **1**) stored in the memory **420**, for example. The processor **470** may include various processing circuitry and/or multiple processors. For example, as used herein, including the claims, the term “processor” may include various processing circuitry, including at least one processor, wherein one or more of at least one processor, individually and/or collectively in a distributed manner, may be configured to perform various functions described herein. As used herein, when “a processor”, “at least one processor”, and “one or more processors” are described as being configured to perform numerous functions, these terms cover situations, for example and without limitation, in which one processor performs some of recited functions and another processor(s) performs other of recited functions, and also situations in which a single processor may perform all recited functions. Additionally, the at least one processor may include a combination of processors performing various of the recited/disclosed functions, e.g., in a distributed manner. At least one processor may execute program instructions to achieve or perform various functions.

[0085] In an embodiment, in a state in which the piezoelectric element **440** and the sound output circuit **450** are electrically connected, the processor **470** may identify whether a connection to an

external electronic device is established through the short-range communication circuit **410**. For example, in case that the electronic device **401** is positioned within a designated distance from the external electronic device, the processor **470** may establish a communication connection to the external electronic device through the short-range communication circuit **410**. In case that a communication connection to the external electronic device is established through the short-range communication circuit **410**, the processor **470** may control the switching circuit **430** such that the piezoelectric element **440** and the touch sensing circuit **460** are electrically connected.
[0086] In an embodiment, the processor **470** may identify whether a touch input is detected on the piezoelectric element **440** through the touch sensing circuit **460**. In case that a touch input is detected through the touch sensing circuit **460**, the processor **470** may control the switching circuit **430** such that the piezoelectric element **440** and the sound output circuit **450** are electrically connected. The processor **470** may cause the piezoelectric element **440** to vibrate and thus output sounds through the sound output circuit **450**. For example, upon detecting a change in capacitance caused by a conductive object (for example, finger) that contacts the piezoelectric element **440** through the touch sensing circuit **460**, the processor **470** may determine (or identify) that a touch input has been detected from the piezoelectric element **440**. Based on determining (or identifying) that a touch input has been detected from the piezoelectric element **440**, the processor **470** may control the switching circuit **430** such that the piezoelectric element **440** and the sound output circuit **450** are electrically connected.
[0087] In an embodiment, upon detecting a touch input on the piezoelectric element **440** through the touch sensing circuit **460**, the processor **470** may transmit a signal related to the touch input to the external electronic device such that the external electronic device performs the function corresponding to the detected touch input.
[0088] In an embodiment, sounds output through the sound output circuit **450** may include a sound output to identify (or inform) that a touch input has been detected and/or a sound for identifying (or informing) a function performed by the external electronic device or by an IoT device having a communication connection to the external electronic device.
[0089] In an embodiment, the processor **470** may control the switching circuit **430** such that the piezoelectric element **440** and the touch sensing circuit **460** are electrically connected after sounds are output through the sound output circuit **450**.
[0090] In an embodiment, if a touch input is detected on the piezoelectric element **440** through the touch sensing circuit **460** in a state in which the piezoelectric element **440** and the touch sensing circuit **460** are electrically connected, the processor **470** may configure the cycle at which touch inputs are scanned through the touch sensing circuit **460** to be a first cycle (for example, about 100 ms). After configuring the cycle at which touch inputs are scanned through the touch sensing circuit **460** to be the first cycle (for example, about 100 ms), the processor **470** may identify whether a touch input is detected on the piezoelectric element **440** through the touch sensing circuit **460** and, if there is still no touch input is detected on the piezoelectric element **440**, the processor **470** may configure the cycle at which touch inputs are scanned through the touch sensing circuit **460** to be a second cycle (for example, about 200 ms) which is longer than the first cycle (for example, about 100 ms). After configuring the cycle at which touch inputs are scanned through the touch sensing circuit **460** to be the second cycle (for example, about 200 ms), the processor **470** may identify whether a touch input is detected on the piezoelectric element **440** and, upon identifying a touch input detected on the piezoelectric element **440**, the processor **470** may configure the cycle at which touch inputs are scanned through the touch sensing circuit **460** to be a the first cycle (for example, about 100 ms) which is shorter than the second cycle (for example, about 200 ms).
[0091] In an embodiment, in case that there is no communication connection to the external electronic device established through the short-range communication circuit **410** in a state in which the piezoelectric element **440** and the sound output circuit **450** are electrically connected, the processor **470** may maintain the electric connection between the piezoelectric element **440** and the

sound output circuit **450**.

[0092] An electronic device according to various example embodiments may include: a housing and a piezoelectric element disposed to one surface of the housing in an inner space of the housing; a short-range communication circuit; a sound output circuit; a touch sensing circuit; at least one switching circuit configured to control the electric connection between the piezoelectric element and the sound output circuit or the electric connection between the piezoelectric element and the touch sensing circuit; at least one processor, comprising processing circuitry, operatively connected to the piezoelectric element, the short-range communication circuit, the sound output circuit, the touch sensing circuit, and the at least one switching circuit, wherein at least one processor, individually and/or collectively, may be configured to: based on a communication connection to an external electronic device being established through the short-range communication circuit in a state in which the piezoelectric element and the sound output circuit are electrically connected, control the at least one switching circuit such that the piezoelectric element and the touch sensing circuit are electrically connected; based on a touch input being detected from the piezoelectric element through the touch sensing circuit, control the at least one switching circuit such that the piezoelectric element and the sound output circuit are electrically connected, and may output a sound through the sound output circuit; and control the at least one switching circuit such that the piezoelectric element and the touch sensing circuit are electrically connected, after outputting the sound through the sound output circuit.

[0093] In an example embodiment, at least one processor, individually and/or collectively, may be configured to: determine that a touch input is detected from the piezoelectric element based on a change in capacitance being detected through the touch sensing circuit as a result of a contact between a conductive object and the piezoelectric element in a state in which the piezoelectric element and the touch sensing circuit are electrically connected.

[0094] In an example embodiment, at least one processor, individually and/or collectively, may be configured to: based on a touch input being detected from the piezoelectric element through the touch sensing circuit, control the electronic device transmit a signal related to the touch input to the external electronic device through the short-range communication circuit such that the external electronic device or an Internet-of-things (IoT) device having a communication connection to the external electronic device performs a function corresponding to the detected touch input.

[0095] In an example embodiment, sounds output through the sound output circuit may include at least one of a sound output identifying that the touch input has been detected from the piezoelectric element, and a sound for identifying a function performed by the external electronic device or the IoT device having a communication connection to the external electronic device.

[0096] In an example embodiment, at least one processor, individually and/or collectively, may be configured to: based on a sound output-related signal being received from the external electronic device through the short-range communication circuit, control the at least one switching circuit such that the piezoelectric element and the sound output circuit are electrically connected, and output a sound related to the signal received from the external electronic device through the sound output circuit.

[0097] In an example embodiment, the sound output-related signal may include a signal requesting a sound output for identifying the position of the electronic device.

[0098] In an example embodiment, at least one processor, individually and/or collectively, may be configured to: based on the touch input not being detected from the piezoelectric element through the touch sensing circuit, configure the cycle at which the touch input is scanned through the touch sensing circuit to be a first cycle.

[0099] In an example embodiment, at least one processor, individually and/or collectively, may be configured to: based on the touch input not being detected from the piezoelectric element through the touch sensing circuit in a state in which the cycle at which the touch input is scanned through the touch sensing circuit is configured to be the first cycle, configure the cycle at which the touch

input is scanned through the touch sensing circuit to be a second cycle longer than the first cycle.
[0100] In an example embodiment, at least one processor, individually and/or collectively, may be configured to: based on the touch input being detected from the piezoelectric element through the touch sensing circuit in a state in which the cycle at which the touch input is scanned through the touch sensing circuit is configured to be the second cycle, configure the cycle at which the touch input is scanned through the touch sensing circuit to be the first cycle shorter than the second cycle.
[0101] In an example embodiment, at least one processor, individually and/or collectively, may be configured to maintain the electric connection between the piezoelectric element and the sound output circuit based on no connection to an external electronic device being established through the short-range communication circuit.
[0102] In an example embodiment, at least one processor, individually and/or collectively, may be configured to: identify whether the communication connection to the external electronic device has been released; and based on identifying that the communication connection to the external electronic device has been released, control the at least one switching circuit such that the piezoelectric element and the sound output circuit are electrically connected.
[0103] In an example embodiment, the electronic device may include a position tracking device mountable on an object.
[0104] FIG. **5**A and FIG. **5**B are circuit diagrams **500** and **550** illustrating a sound output circuit **450**, a touch sensing circuit **460**, and at least one switching circuit **430** according to various embodiments.
[0105] Referring to FIG. **5**A and FIG. **5**B, reference numeral <**510**> may indicate the circuit diagram of a sound output circuit (for example, the sound output circuit **450** in FIG. **4**), and reference numeral <**520**> may indicate the circuit diagram of a touch sensing circuit (for example, the touch sensing circuit **460** in FIG. **4**).
[0106] The circuit diagram of the sound output circuit **450** and the circuit diagram of the touch sensing circuit **460** indicated by reference numeral <**510**> and reference numeral <**520**> in FIG. **5**A and FIG. **5**B according to various embodiments are only examples for describing the disclosure, which is not limited to the circuit diagrams illustrated in FIG. **5**A and FIG. **5**B.
[0107] As illustrated in FIG. **5**A according to an embodiment, the electronic device (for example, the electronic device **401** in FIG. **4**) may include a switching circuit **430**. The switching circuit **430** may electrically connect a piezoelectric element (for example, the piezoelectric element **440** in FIG. **4**) and the sound output circuit **450** under the control of a processor (for example, the processor **470** in FIG. **4**), or may electrically connect the piezoelectric element **440** and the touch sensing circuit **460**.
[0108] For example, if a communication connection to an external electronic device is established through a short-range communication circuit (for example, the short-range communication circuit **410** in FIG. **4**), the processor **470** may control the switching circuit **430** to be turned on (for example, short-circuited state), thereby electrically connecting the piezoelectric element **440** and the touch sensing circuit **460**.
[0109] As another example, if the communication connection to an external electronic device is released, or if a sound output-related signal is received, the processor **470** may control the switching circuit **430** to be turned off (for example, open state), thereby blocking the electric connection between the piezoelectric element **440** and the touch sensing circuit **460**, and electrically connecting the piezoelectric element **440** and the sound output circuit **450**.
[0110] Although it has been described with reference to FIG. **5**A according to various embodiments that one switching circuit **430** is used to electrically connect the piezoelectric element **440** and the sound output circuit **450** or to electrically connect the piezoelectric element **440** and the touch sensing circuit **460**, the disclosure is not so limited.
[0111] For example, as illustrated in FIG. **5**B according to an embodiment, the electronic device **401** may include multiple switching circuits. For example, the multiple switching circuits may

include a first switching circuit **430***a*, a second switching circuit **430***b*, and a third switching circuit **430***c*. However, the disclosure is not limited thereto.
[0112] In an embodiment, the multiple switching circuits may electrically connect the piezoelectric element **440** and the sound output circuit **450** or may electrically connect the piezoelectric element **440** and the touch sensing circuit **460** under the control of the processor **470**.
[0113] For example, if a communication connection to an external electronic device is established through the short-range communication circuit **410**, the processor **470** may control the second switching circuit **430***b* and the third switching circuit **430***c* to be turned off (for example, open state) and may control the first switching circuit **430***a* to be turned on (for example, short-circuited state), thereby electrically connecting the piezoelectric element **440** and the touch sensing circuit **460**.
[0114] As another example, if the communication connection to an external electronic device is released, or if a sound output-related signal is received, the processor **470** may control the second switching circuit **430***b* and the third switching circuit **430***c* to be turned on (for example, short-circuited state) may control the first switching circuit **430***a* to be turned off (for example, open state), thereby blocking the electric connection between the piezoelectric element **440** and the touch sensing circuit **460**, and electrically connecting the piezoelectric element **440** and the sound output circuit **450**.
[0115] The switching circuit **430** illustrated in FIG. **5**A according to various embodiments and the multiple switching circuits illustrated in FIG. **5**B (for example, the first switching circuit **430***a*, the second switching circuit **430***b*, and the third switching circuit **430***c*) may include a metal oxide semiconductor field effect transistor (MOSFET) switching circuit or an analog switching circuit. However, the disclosure is not limited thereto.
[0116] FIG. **6** is a flowchart **600** illustrating an example method for controlling the electric connection between a piezoelectric element **440** and a sound output circuit **450** or the electric connection between a piezoelectric element **440** and a touch sensing circuit **460** according to various embodiments.
[0117] In the following example, respective operations may be performed successively, but are not necessarily performed successively. For example, the order of respective operations may be changed, and at least two operations may be performed in parallel.
[0118] In an embodiment, it may be understood that operations **610** to **630** are performed by the processor (for example, the processor **470** in FIG. **4**) of the electronic device (for example, the electronic device **401** in FIG. **4**).
[0119] Prior to performing operation **610** described below in various embodiments, information of the electronic device **401** may already been stored in the memory of an external electronic device.
[0120] For example, the electronic device **401** may be a small position tracking device (for example, a tag device) which can be mounted on an object (for example, a bag or a bicycle). The external electronic device may be an electronic device such as a smartphone, or a wearable electronic device which can be worn on a part of the user's body, such as a smart watch.
[0121] In an embodiment, the external electronic device may share, in the memory thereof, information of the electronic device **401** received from the electronic device **401** through an operation of paring with the electronic device **401** using a short-range communication circuit with the electronic device **401**. For example, information of the electronic device **401** may include the type of the electronic device **401** (for example, a tag device, a wearable electronic device, a tablet device, or a portable communication device (for example, a smartphone)), identity information (for example, identification (ID)), manufacturer information, hardware information (for example, processor performance, memory capacity, and/or battery capacity), and/or communication performance-related information (for example, whether short-range communication is supported or not).
[0122] In an embodiment, the electronic device **401** may be in a state in which the same is

registered in the external electronic device (for example, in a state in which the same is stored in the memory of the external electronic device) as a device used to prevent and/or reduce or avoid the loss of the object on which the electronic device **401** is mounted, based on position information of the electronic device **401**.

[0123] In an embodiment, the electronic device **401** may also store information of the external electronic device received from the external electronic device through pairing with the external electronic device using a short-range communication circuit (for example, the short-range communication circuit **410** in FIG. **4**) in the memory (for example, the memory **420** in FIG. **4**). The information of the external electronic device through may include the type of the external electronic device (for example, a tag device, a wearable electronic device, a tablet device, or a portable communication device (for example, a smartphone)), identity information (for example, ID), manufacturer information, hardware information (for example, processor performance, memory capacity, and/or battery capacity), and/or communication performance-related information (for example, whether short-range communication is supported or not).

[0124] Referring to FIG. **6**, in operation **610**, in case that a communication connection to an external electronic device is established through the short-range communication circuit **410** in a state in which a piezoelectric element (for example, the piezoelectric element **440** in FIG. **4**) and a sound output circuit (for example, the sound output circuit **450** in FIG. **4**) are electrically connected, the processor **470** may control at least one switching circuit (for example, the switching circuit **430** in FIG. **4**) such that the piezoelectric element **440** and a touch sensing circuit (for example, the touch sensing circuit **460** in FIG. **4**) are electrically connected.

[0125] In an embodiment, in a state in which the electronic device **401** is mounted on an object without a communication connection to the external electronic device, the piezoelectric element **440** and the sound output circuit **450** may be electrically connected. In case that the electronic device **401** has no communication connection to the external electronic device, the distance between the electronic device **401** and the external electronic device may exceed a designated distance, for example.

[0126] In an embodiment, according to a state in which the distance between the electronic device **401** and the external electronic device is within the designated distance, the electronic device **401** may have a communication connection to the external electronic device established through the short-range communication circuit **410**. In case that the external electronic device and the electronic device **401** are connected through the short-range communication circuit **410**, the electronic device **401** may be used as a device for controlling the external electronic device so as to perform a specific function. The disclosure is not so limited, and in case that the external electronic device and the electronic device **401** are connected through the short-range communication circuit **410**, the electronic device **401** may be used as a device for controlling an Internet-of-things (IoT) device having a communication connection to the external electronic device so as to perform a specific function.

[0127] In an embodiment, the external electronic device may transmit a sound output-related signal to the electronic device **401**. For example, the sound output-related signal may be a signal for requesting a sound output for identifying the position of the electronic device **401** (and/or the position of the object on which the electronic device **401** is mounted). Based on the sound output-related signal received from the external electronic device, the processor **470** may cause the piezoelectric element **440** and thus output sounds through the sound output circuit **450**. As sounds are output through the sound output circuit **450**, the user of the external electronic device may intuitively identify the position of the electronic device **401** and/or the position of the object on which the electronic device **401** is mounted.

[0128] In an embodiment, in case that a communication connection to the external electronic device is established through the short-range communication circuit **410**, the processor **470** may control at least one switching circuit **430** such that the piezoelectric element **440** and the touch

sensing circuit **460** are electrically connected, thereby identifying whether touch inputs are detected from the piezoelectric element **440**. For example, the processor **470** may identify, through the touch sensing circuit **460**, whether a change in capacitance is detected according to whether or not a conductive object (for example, a finger) contacts the piezoelectric element **440**, thereby identifying whether touch inputs are detected from the piezoelectric element **440**.

[0129] In an embodiment, in operation **620**, upon detecting a touch input from the piezoelectric element **440** through the touch sensing circuit **460**, the processor **470** may control at least one switching circuit **430** such that the piezoelectric element **440** and the sound output circuit **450** are electrically connected, and may output sounds through the sound output circuit **450**.

[0130] In an embodiment, upon identifying that a change in capacitance is detected through the touch sensing circuit **460** as a conductive object (for example, a finger) contacts the piezoelectric element **440**, the processor **470** may determine (or identify) that a touch input has been detected from the piezoelectric element **440**.

[0131] In an embodiment, sounds output through the sound output circuit **450** may include a sound output to identify (or inform) that a touch input has been detected from the piezoelectric element **440**. However, the disclosure is not limited thereto. In case that a touch input is detected, a sound may be output through the sound output circuit **450**, and the user of the electronic device **401** may thus intuitively identify that a touch input has been detected.

[0132] In an embodiment, in operation **630**, the processor **470** may control at least one switching circuit **430** such that the piezoelectric element **440** and the touch sensing circuit **460** are electrically connected, after outputting a sound.

[0133] In an embodiment, after controlling at least one switching circuit **430** such that the piezoelectric element **440** and the touch sensing circuit **460** are electrically connected, the processor **470** may repeatedly perform operations **620** and **630**, based on detection of a touch input from the piezoelectric element **440**.

[0134] Although not illustrated in various embodiments, upon detecting a touch input from the piezoelectric element **440** through the touch sensing circuit **460**, the processor **470** may transmit a signal related to the touch input to the external electronic device through the short-range communication circuit **410** such that the external electronic device performs a function corresponding to the detected touch input. for example, the touch input may correspond to a specific function of the external electronic device. Based on determining (or identifying) that touch input is detected from the piezoelectric element **440**, the processor **470** may transmit a signal related to the touch input to the external electronic device through the short-range communication circuit **410** such that the external electronic device performs a function corresponding to the detected touch input.

[0135] The disclosure is not so limited, and the touch input, for example, may correspond to a specific function of an Internet-of-things (IoT) device having a communication connection to the external electronic device. In this case, based on determining (or identifying) that touch input is detected from the piezoelectric element **440**, the processor **470** may transmit a signal related to the touch input to the external electronic device through the short-range communication circuit **410** such that the IoT device having a communication connection to the external electronic device performs a function corresponding to the detected touch input.

[0136] According to an embodiment, in case that the above-described touch input-related signal is transmitted to the external electronic device, the sound output through the sound output circuit **450** in operation **630** may include a sound for identifying (or informing) a function performed by the external electronic device or an IoT device having a communication connection to the external electronic device. As the sound for identifying (or informing) a function performed by the external electronic device or an IoT device having a communication connection to the external electronic device is output through the sound output circuit **450**, the user of the electronic device **401** may intuitively identify that a function is performed by the external electronic device or an IoT device

having a communication connection to the external electronic device.
[0137] Although it has been described with reference to FIG. **6** according to various embodiments that, if a touch input is detected from the piezoelectric element **440** through the touch sensing circuit **460**, the piezoelectric element **440** and the sound output circuit **450** are electrically connected such that sounds are output through the sound output circuit **450**, the disclosure is not limited thereto.
[0138] For example, in a state in which the piezoelectric element **440** and the touch sensing circuit **460** are electrically connected, the processor **470** may receive a sound output-related signal from the external electronic device. The sound output-related signal may be a signal for requesting a sound output for identifying the position of the electronic device **401** (and/or the position of the object on which the electronic device **401** is mounted). Upon receiving the sound output-related signal from the external electronic device, the processor **470** may control at least one switching circuit **430** such that the piezoelectric element **440** and the sound output circuit **450** are electrically connected. Based on the sound output-related signal received from the external electronic device, the processor **470** may cause the piezoelectric element **440** and thus output sounds through the sound output circuit **450**. After outputting sounds through the sound output circuit **450**, the processor **470** may control at least one switching circuit **430** such that the piezoelectric element **440** and the touch sensing circuit **460** are electrically connected.
[0139] FIG. **7** is a flowchart **700** illustrating an example method for controlling the electric connection between a piezoelectric element **440** and a sound output circuit **450** or the electric connection between a piezoelectric element **440** and a touch sensing circuit **460** according to various embodiments.
[0140] In an embodiment, it may be understood that operation **710** is performed by the processor (for example, the processor **470** in FIG. **4**) of the electronic device (for example, the electronic device **401** in FIG. **4**).
[0141] FIG. **7** is a flowchart illustrating an example additional operation of above-described operation **610** in FIG. **6** according to various embodiments.
[0142] Referring to FIG. **7**, in operation **710**, in case that no communication connection to an external electronic device is established through a short-range communication circuit (for example, the short-range communication circuit **410** in FIG. **4**) in a state in which a piezoelectric element (for example, the piezoelectric element **440** in FIG. **4**) and a sound output circuit (for example, the sound output circuit **450** in FIG. **4**) are electrically connected, the processor **470** may maintain the electric connection between the piezoelectric element **440** and the sound output circuit **450**.
[0143] In case that the electronic device **401** has no communication connection to the external electronic device established through the short-range communication circuit **410** in a state in which the piezoelectric element **440** and the sound output circuit **450** are electrically connected, the distance between the electronic device **401** which is mounted on an object (for example, a bag or a bicycle), for example, and the external electronic device may exceed a designated distance.
[0144] Although it has been described with reference to FIG. **7** according to various embodiments that, in the absence of a communication connection to the external electronic device established through the short-range communication circuit **410**, the piezoelectric element **440** and the sound output circuit **450** remain electrically connected, the disclosure is not so limited. For example, even in a state in which there is no communication connection to the external electronic device established through the short-range communication circuit **410**, the processor **470** may control at least one switching circuit (for example, the switching circuit **430** in FIG. **4**) such that the piezoelectric element **440** and a touch sensing circuit (for example, the touch sensing circuit **460** in FIG. **4**) are electrically connected. In this case, the processor **470** may identify whether a touch input on the piezoelectric element **440** is detected through the touch sensing circuit **460**. Upon detecting a touch input on the piezoelectric element **440** through the touch sensing circuit **460**, the processor **470** may control at least one switching circuit **430** such that the piezoelectric element **440**

and the sound output circuit **450** are electrically connected, and may output sounds through the sound output circuit **450**. For example, sounds output through the sound output circuit **450** may include a sound output to identify (or inform) that a touch input has been detected from the piezoelectric element **440**.

[0145] FIG. **8** is a flowchart **800** illustrating example operations in FIG. **6** and FIG. **7** according to various embodiments.

[0146] In the following embodiment, respective operations may be performed successively, but are not necessarily performed successively. For example, the order of respective operations may be changed, and at least two operations may be performed in parallel.

[0147] In an embodiment, it may be understood that operations **805** to **850** are performed by the processor (for example, the processor **470** in FIG. **4**) of the electronic device (for example, the electronic device **401** in FIG. **4**).

[0148] Operations **805** to **823** and operations **835** to **845** in FIG. **8** according to various embodiments are identical to the above-described operations **610** to **630** in FIG. **6**, and detailed descriptions thereof will not be repeated herein. In addition, operation **850** in FIG. **8** according to various embodiments is identical to the above-described operation **710** in FIG. **7**, and detailed descriptions thereof will not be repeated herein.

[0149] Referring to FIG. **8**, in operation **805**, the processor **470** may control at least one switching circuit (for example, the switching circuit **430** in FIG. **4**) such that the piezoelectric element (for example, the piezoelectric element **440** in FIG. **4**) and the sound output circuit (for example, the sound output circuit **450** in FIG. **4**) are electrically connected.

[0150] In an embodiment, the electronic device **401** may be a position tracking device (for example, a tag device) mounted on an object (for example, a bag or a bicycle). In this case, the electronic device **401** may be used to track the position of the object on which the electronic device **401** is mounted.

[0151] For example, the electronic device **401** may transmit the position information thereof to an external electronic device having a communication connection thereto, and the server may track the position of the electronic device **401** and/or the position of the object on which the electronic device **401** is mounted, using the position information of the electronic device **401**.

[0152] In an embodiment, in operation **810**, the processor **470** may identify whether a connection to an external electronic device is established through a short-range communication circuit (for example, the short-range communication circuit **410** in FIG. **4**).

[0153] For example, the electronic device **401** may have a communication connection to an external electronic device through the short-range communication circuit **410** if the distance between the electronic device **401** and the external electronic device is within a designated distance.

[0154] In an embodiment, in case that a communication connection to an external electronic device is established through the short-range communication circuit **410** (YES in operation **810**), the processor **470** may control at least one switching circuit **430** such that the piezoelectric element **440** and a touch sensing circuit (for example, the touch sensing circuit **460** in FIG. **4**) are electrically connected in operation **815**. In an embodiment, the processor **470** may identify whether a touch input is detected from the piezoelectric element **440** through the touch sensing circuit **460** in operation **820**. Upon detecting a touch input from the piezoelectric element **440** through the touch sensing circuit **460** (YES in operation **820**), the processor **470** may control at least one switching circuit **430** such that the piezoelectric element **440** and the sound output circuit **450** are electrically connected, and may then output sounds through the sound output circuit **450**, operation **821**. In this case, sounds output through the sound output circuit **450** may include a sound output to identify (or inform) that a touch input has been detected from the piezoelectric element **440**.

[0155] In an embodiment, in operation **823**, the processor **470** may control at least one switching circuit **430** such that the piezoelectric element **440** and the touch sensing circuit **460** are electrically

connected, after outputting a sound.
[0156] For example, upon detecting a change in capacitance caused by a conductive object (for example, finger) that contacts the piezoelectric element **440** through the touch sensing circuit **460**, the processor **470** may determine (or identify) that a touch input has been detected from the piezoelectric element **440**. Based on determining (or identifying) that a touch input has been detected from the piezoelectric element **440**, the processor **470** may control at least one switching circuit **430** such that the piezoelectric element **440** and the sound output circuit **450** are electrically connected, and may then output sounds through the sound output circuit **450**.
[0157] In various embodiments, although not illustrated, upon detecting a touch input from the piezoelectric element **440** through the touch sensing circuit **460**, the processor **470** may transmit a signal related to the touch input to the external electronic device such that the external electronic device performs a function corresponding to the detected touch input. The disclosure is not limited thereto, and based on determining (or identifying) that touch input is detected from the piezoelectric element **440**, the processor **470** may transmit a signal related to the touch input to the external electronic device such that an IoT device having a communication connection to the external electronic device performs a function corresponding to the detected touch input. In case that the touch input-related signal is transmitted to the external electronic device, the sound output through the sound output circuit **450** in operation **823** may include a sound for identifying (or informing) a function performed by the external electronic device or by the IoT device having a communication connection to the external electronic device.
[0158] In an embodiment, in operation **830**, the processor **470** may identify whether the communication connection to an external electronic device is released. Upon identifying that the communication connection to an external electronic device is released (YES in operation **830**), the processor **470** may perform operation **805** in which at least one switching circuit **430** is controlled such that the piezoelectric element **440** and the sound output circuit **450** are electrically connected.
[0159] In an embodiment, if it is not identified that the communication connection to an external electronic device has been released (NO in operation **830**), the processor **470** may perform operation **820** in which it is identified whether a touch input is detected from the piezoelectric element **440** through the touch sensing circuit **460**.
[0160] In an embodiment, if there is no communication connection to the external electronic device established through the short-range communication circuit **410** (NO in operation **810**), the processor **470** may maintain the electric connection between the piezoelectric element **440** and the sound output circuit **450** in operation **850**.
[0161] In an embodiment, if no touch input is detected from the piezoelectric element through the touch sensing circuit **460** (for example, NO in operation **820**), the processor **470** may identify whether a sound output-related signal is received from the external electronic device in operation **835**. For example, the sound output-related signal may be a signal for requesting a sound output for identifying the position of the electronic device **401** (and/or the position of the object on which the electronic device **401** is mounted).
[0162] In an embodiment, if a sound output-related signal is received from the external electronic device (for example, YES in operation **835**), the processor **470** may control at least one switching circuit **430** such that the piezoelectric element **440** and the sound output circuit **450** are electrically connected in operation **840**, and may then output sounds through the sound output circuit **450** in operation **845**. The processor **470** may perform operation **815** in which at least one switching circuit **430** is controlled such that the piezoelectric element **440** and the touch sensing circuit **460** are electrically connected, after outputting sounds.
[0163] In an embodiment, if no sound output-related signal is received from the external electronic device (for example, NO in operation **835**), the processor **470** may perform operation **830** in which it is identified whether the communication connection to the external electronic device has been released.

[0164] Although it has been described in various embodiments that the process is ended after maintaining the state in which the piezoelectric element **440** and the sound output circuit **460** are electrically connected in operation **850**, the disclosure is not so limited. For example, in a state in which the piezoelectric element **440** and the sound output circuit **460** remain electrically connected, the processor **470** may perform operation **810** in which it is identified whether a connection to an external electronic device has been established through the short-range communication circuit **410**.
[0165] In FIG. **6**, FIG. **7** and FIG. **8** according to various embodiments, in case that the electronic device **401** has a communication connection to an external electronic device established through the short-range communication circuit **410**, the electronic device **401** may be used as a device for controlling the external electronic device to perform a specific function or for controlling an IoT device having a communication connection to the external electronic device to perform a specific function, instead of being used to prevent and/or reduce or limit or avoid the loss of the object on which the electronic device **401** is mounted, using position information of the electronic device **401**. In consideration thereof, the processor **470** may electrically connect the piezoelectric element **440** and the touch sensing circuit **460** if the electronic device **401** has a communication connection to an external electronic device such that the piezoelectric element **440** is used to detect touch inputs. In addition, if necessary (for example, upon receiving a sound output-related signal), the processor **470** may electrically connect the piezoelectric element **440** and the sound output circuit **450** temporarily such that the piezoelectric element **440** is used to output sounds.
[0166] As described above, the piezoelectric element **440** may be used to detect touch inputs or to output sounds according to whether a connection to an external electronic device is established or not, thereby improving the usability of the electronic device **401**.
[0167] FIG. **9** is a flowchart **900** illustrating an example method for adjusting the touch input sensing cycle, based on whether a touch input using a piezoelectric element **440** is detected or not, according to various embodiments.
[0168] In the following example embodiment, respective operations may be performed successively, but are not necessarily performed successively. For example, the order of respective operations may be changed, and at least two operations may be performed in parallel.
[0169] In an embodiment, it may be understood that operations **910** to **950** are performed by the processor (for example, the processor **470** in FIG. **4**) of the electronic device (for example, the electronic device **401** in FIG. **4**).
[0170] FIG. **9** according to various embodiments may illustrate additional operations of the above-described operation **815** in FIG. **8**.
[0171] Operations **910**, **915**, **920**, and **940** in FIG. **9** according to various embodiments are identical to the above-described operations **820**, **821**, **823**, and **830** in FIG. **8**, and detailed descriptions thereof will not be repeated herein.
[0172] Referring to FIG. **9**, in operation **910**, the processor **470** may identify whether a touch input is detected from a piezoelectric element (for example, the piezoelectric element **440** in FIG. **4**) through a touch sensing circuit (for example, the touch sensing circuit **460** in FIG. **4**).
[0173] In an embodiment, the processor **470** may identify, through the touch sensing circuit **460**, whether a change in capacitance is detected according to whether or not a conductive object (for example, a finger) contacts the piezoelectric element **440**, thereby identifying whether touch inputs are detected from the piezoelectric element **440**.
[0174] In an embodiment, if a touch input is detected from the piezoelectric element **440** through the touch sensing circuit **460** (for example, YES in operation **910**), the processor **470** may control at least one switching circuit **430** such that the piezoelectric element **440** and a sound output circuit (for example, the sound output circuit **450** in FIG. **4**) are electrically connected, and may output sounds through the sound output circuit **450**, in operation **915**. The processor **470** may control at least one switching circuit **430** such that the piezoelectric element **440** and the touch sensing circuit **460** are electrically connected, after outputting a sound, in operation **920**. For example, upon

identifying that a touch input is detected from the piezoelectric element **440**, based on detecting a change in capacitance from the piezoelectric element **440** through the touch sensing circuit **460**, the processor **470** may control at least one switching circuit **430** such that the piezoelectric element **440** and the sound output circuit **450** are electrically connected, and may output sounds through the sound output circuit **450**. The disclosure is not so limited, and upon identifying that a touch input is detected from the piezoelectric element **440**, based on detecting a change in capacitance from the piezoelectric element **440** through the touch sensing circuit **460**, the processor **470** may transmit a touch input-related signal to the external electronic device such that the external electronic device (or an IoT device having a communication connection to the external electronic device) performs a function corresponding to the detected touch input. In an embodiment, sounds output through the sound output circuit **450** may include a sound output to identify (or inform) that a touch input has been detected and/or a sound for identifying (or informing) a function performed by the external electronic device or by an IoT device having a communication connection to the external electronic device.

[0175] In an embodiment, in operation **930**, the processor **470** may configure the cycle at which touch inputs are scanned through the touch sensing circuit **460** to be a first cycle. In an embodiment, the first cycle may be about 100 ms. However, the disclosure is not limited thereto.

[0176] In an embodiment, the processor **470** may identify whether the communication connection to an external electronic device is released or not. If the communication connection to the external electronic device is not released (for example, NO in operation **940**), the processor **470** may perform operation **910**. If the communication connection to the external electronic device is released (for example, YES in operation **940**), the processor **470** may perform operation **805** in which at least one switching circuit **430** is controlled such that the piezoelectric element **440** and the sound output circuit **450** are electrically connected in FIG. **8**.

[0177] In an embodiment, if no touch input is detected from the piezoelectric element **440** through the touch sensing circuit **460** (for example, NO in operation **910**), the processor **470** may configure the cycle at which touch inputs are scanned through the touch sensing circuit **460** to be a second cycle which is longer than the first cycle in operation **950**. In an embodiment, the second cycle may be about 200 ms. However, the disclosure is not limited thereto.

[0178] In an embodiment, after configuring the cycle at which touch inputs are canned through the touch sensing circuit **460** to be a second cycle, the processor **470** may perform operation **835** in which it identified whether a sound output-related signal is received from the external electronic device in FIG. **8**.

[0179] In various embodiments, although not illustrated, after configuring the cycle at which touch inputs are scanned through the touch sensing circuit **460** to be the second cycle, the processor **470** may identify whether a touch input is detected from the piezoelectric element **440**. After configuring the cycle at which touch inputs are scanned to be a second cycle, and upon identifying that no touch input is detected from the piezoelectric element **440**, the processor **470** may configure the cycle at which touch inputs are scanned through the touch sensing circuit **460** to be a third cycle which is longer than the second cycle. The third cycle may be about 400 ms. However, the disclosure is not limited thereto.

[0180] In various embodiments, although not illustrated, after configuring the cycle at which touch inputs are scanned through the touch sensing circuit **460** to be the third cycle, the processor **470** may identify whether a touch input is detected from the piezoelectric element **440**. After configuring the cycle at which touch inputs are scanned to be the third cycle, and upon identifying that a touch input is detected from the piezoelectric element **440**, the processor **470** may configure the cycle at which touch inputs are scanned through the touch sensing circuit **460** to be the second or first cycle which is shorter than the third cycle.

[0181] According to various embodiments, it will be assumed in the following description that the amount of current consumed in case that the cycle at which touch inputs are scanned through the

touch sensing circuit **460** is configured to be a first cycle (for example, about 100 ms) is about 16 uA, the amount of current consumed in case that the cycle at which touch inputs are scanned through the touch sensing circuit **460** is configured to be a second cycle (for example, about 200 ms) is about 32 uA, and the amount of current consumed in case that the cycle at which touch inputs are scanned through the touch sensing circuit **460** is configured to be a third cycle (for example, about 400 ms) is about 64 uA.

[0182] In FIG. **9** according to various embodiments, if no touch input is detected from the piezoelectric element **400**, the cycle at which touch inputs on the piezoelectric element **440** are scanned through the touch sensing circuit **460** may be adjusted from the first cycle (for example, about 100 ms) to the second cycle (for example, about 200 ms) or the third cycle (for example, about 400 ms), thereby reducing the amount of consumed current (for example, reduced from about 16 uA to about 32 uA or to about 64 uA).

[0183] A method for detecting a touch input using a piezoelectric element of an electronic device according to various example embodiments may include: based on a communication connection to an external electronic device being established through a short-range communication circuit in a state in which the piezoelectric element and a sound output circuit are electrically connected, controlling at least one switching circuit such that the piezoelectric element and a touch sensing circuit are electrically connected; based on a touch input being detected from the piezoelectric element through the touch sensing circuit, controlling the at least one switching circuit such that the piezoelectric element and the sound output circuit are electrically connected, and outputting a sound through the sound output circuit; and controlling the at least one switching circuit such that the piezoelectric element and the touch sensing circuit are electrically connected, after outputting the sound through the sound output circuit.

[0184] In an example embodiment, the outputting a sound through the sound output circuit may include determining that the touch input is detected from the piezoelectric element based on a change in capacitance being detected through the touch sensing circuit as a result of a contact between a conductive object and the piezoelectric element.

[0185] The method may further include: based on the touch input being detected from the piezoelectric element through the touch sensing circuit, transmitting a signal related to the touch input to the external electronic device through the short-range communication circuit such that the external electronic device or an Internet-of-things (IoT) device having a communication connection to the external electronic device performs a function corresponding to the detected touch input.

[0186] In an example embodiment, sounds output through the sound output circuit may include at least one of a sound output to identify that the touch input has been detected from the piezoelectric element and a sound for identifying a function performed by the external electronic device or the IoT device having a communication connection to the external electronic device.

[0187] The method may further include: based on a sound output-related signal being received from the external electronic device through the short-range communication circuit, controlling the at least one switching circuit such that the piezoelectric element and the sound output circuit are electrically connected, and outputting a sound related to the received signal through the sound output circuit.

[0188] In an example embodiment, the sound output-related signal may include a signal requesting a sound output for identifying the position of the electronic device.

[0189] The method may further include: based on the touch input not being detected from the piezoelectric element through the touch sensing circuit, configuring the cycle at which the touch input is scanned through the touch sensing circuit to be a first cycle.

[0190] The method may further include: based on the touch input not being detected from the piezoelectric element through the touch sensing circuit in a state in which the cycle at which the touch input is scanned through the touch sensing circuit is configured to be the first cycle, configuring the cycle at which the touch input is scanned through the touch sensing circuit to be a

second cycle longer than the first cycle.
[0191] The method may further include: based on the touch input being detected from the piezoelectric element through the touch sensing circuit in a state in which the cycle at which the touch input is scanned through the touch sensing circuit is configured to be the second cycle, configuring the cycle at which the touch input is scanned through the touch sensing circuit to be the first cycle shorter than the second cycle.
[0192] The method may further include: maintaining the electric connection between the piezoelectric element and the sound output circuit based on no connection to an external electronic device being established through the short-range communication circuit.
[0193] The method may further include: identifying whether the communication connection to the external electronic device has been released; based on identifying that the communication connection to the external electronic device has been released, controlling the at least one switching circuit such that the piezoelectric element and the sound output circuit are electrically connected.
[0194] In an example embodiment, the electronic device may include a position tracking device mountable on an object.
[0195] 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, a home appliance, or the like. According to an embodiment of the disclosure, the electronic devices are not limited to those described above.
[0196] It should be appreciated that various embodiments of the 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), the element may be coupled with the other element directly (e.g., through wires), wirelessly, or via a third element.
[0197] As used in connection with various embodiments of the disclosure, the term “module” may include a unit implemented in hardware, software, or firmware, or any combination thereof, 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).
[0198] Various embodiments as set forth herein may be implemented as software (e.g., the program **140**) including one or more instructions that are stored in a storage medium (e.g., internal memory **136** or external memory **138**) that is readable by a machine (e.g., the electronic device **101**). For example, a processor (e.g., the processor **120**) of the machine (e.g., the electronic device **101**) 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 compiler 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 “non-transitory” storage medium is a tangible device, and may 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.

[0199] 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.

[0200] 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.

[0201] While the disclosure has been illustrated and described with reference to various example embodiments, it will be understood that the various embodiments are intended to be illustrative, not limiting. It will be further understood by those skilled in the art that various changes in form and detail may be made without departing from the true spirit and full scope of the disclosure, including the appended claims and their equivalents. It will also be understood that any of the embodiment(s) described herein may be used in conjunction with any other embodiment(s) described herein.

Claims

1. An electronic device comprising: a housing; a piezoelectric element disposed to one surface of the housing in an inner space of the housing; a short-range communication circuit; a sound output circuit; a touch sensing circuit; at least one switching circuit configured to control the electric connection between the piezoelectric element and the sound output circuit or the electric connection between the piezoelectric element and the touch sensing circuit; and at least one processor, comprising processing circuitry, operatively connected to the piezoelectric element, the short-range communication circuit, the sound output circuit, the touch sensing circuit, and the at least one switching circuit, wherein at least one processor, individually and/or collectively, is configured to: based on a communication connection to an external electronic device being established through the short-range communication circuit in a state in which the piezoelectric element and the sound output circuit are electrically connected, control the at least one switching circuit such that the piezoelectric element and the touch sensing circuit are electrically connected; based on a touch input being detected from the piezoelectric element through the touch sensing circuit, control the at least one switching circuit such that the piezoelectric element and the sound output circuit are electrically connected, and output a sound through the sound output circuit; and

control the at least one switching circuit such that, after outputting the sound, the piezoelectric element and the touch sensing circuit are electrically connected.

2. The electronic device of claim 1, wherein at least one processor, individually and/or collectively, is configured to: determine that the touch input is detected from the piezoelectric element based on a change in capacitance being detected through the touch sensing circuit as a result of a contact between a conductive object and the piezoelectric element in a state in which the piezoelectric element and the touch sensing circuit are electrically connected.

3. The electronic device of claim 1, wherein at least one processor, individually and/or collectively, is configured to: based on the touch input being detected from the piezoelectric element through the touch sensing circuit, transmit a signal related to the touch input to the external electronic device through the short-range communication circuit such that the external electronic device or an Internet-of-things (IoT) device having a communication connection to the external electronic device performs a function corresponding to the detected touch input, and wherein the sound output through the sound output circuit comprises at least one of a sound output identifying that the touch input has been detected from the piezoelectric element, and a sound identifying a function performed by the external electronic device or the IoT device having a communication connection to the external electronic device.

4. The electronic device of claim 1, wherein at least one processor, individually and/or collectively, is configured to: based on a sound output-related signal being received from the external electronic device through the short-range communication circuit, control the at least one switching circuit such that the piezoelectric element and the sound output circuit are electrically connected, and output a sound related to the received signal through the sound output circuit, and wherein the sound output-related signal comprises a signal requesting a sound output for identifying the position of the electronic device.

5. The electronic device of claim 1, wherein at least one processor, individually and/or collectively, is configured to: based on the touch input not being detected from the piezoelectric element through the touch sensing circuit, configure a cycle at which the touch input is scanned through the touch sensing circuit to be a first cycle.

6. The electronic device of claim 5, wherein at least one processor, individually and/or collectively, is configured to: based on the touch input not being detected from the piezoelectric element through the touch sensing circuit in a state in which the cycle at which the touch input is scanned through the touch sensing circuit is configured to be the first cycle, configure the cycle at which the touch input is scanned through the touch sensing circuit to be a second cycle longer than the first cycle.

7. The electronic device of claim 6, wherein at least one processor, individually and/or collectively, is configured to: based on the touch input being detected from the piezoelectric element through the touch sensing circuit in a state in which the cycle at which the touch input is scanned through the touch sensing circuit is configured to be the second cycle, configure the cycle at which the touch input is scanned through the touch sensing circuit to be the first cycle shorter than the second cycle.

8. The electronic device of claim 1, wherein at least one processor, individually and/or collectively, is configured to maintain the electric connection between the piezoelectric element and the sound output circuit based on no connection to an external electronic device being established through the short-range communication circuit.

9. The electronic device of claim 1, wherein at least one processor, individually and/or collectively, is configured to: identify whether the communication connection to the external electronic device has been released; and based on identifying that the communication connection to the external electronic device has been released, control the at least one switching circuit such that the piezoelectric element and the sound output circuit are electrically connected.

10. The electronic device of claim 1, wherein the electronic device comprises a position tracking device mountable on an object.

11. A method for detecting a touch input using a piezoelectric element of an electronic device, the method comprising: based on a communication connection to an external electronic device being established through a short-range communication circuit in a state in which the piezoelectric element and a sound output circuit are electrically connected, controlling at least one switching circuit such that the piezoelectric element and a touch sensing circuit are electrically connected; based on a touch input being detected from the piezoelectric element through the touch sensing circuit, controlling the at least one switching circuit such that the piezoelectric element and the sound output circuit are electrically connected, and outputting a sound through the sound output circuit; and controlling the at least one switching circuit such that, after outputting the sound, the piezoelectric element and the touch sensing circuit are electrically connected.

12. The method of claim 11, wherein the outputting of a sound through the sound output circuit comprises: determining that the touch input is detected from the piezoelectric element based on a change in capacitance being detected through the touch sensing circuit as a result of a contact between a conductive object and the piezoelectric element.

13. The method of claim 11, further comprising: based on the touch input being detected from the piezoelectric element through the touch sensing circuit, transmitting a signal related to the touch input to the external electronic device through the short-range communication circuit such that the external electronic device or an Internet-of-things (IoT) device having a communication connection to the external electronic device performs a function corresponding to the detected touch input, and wherein the sound output through the sound output circuit comprises at least one of a sound output identifying that the touch input has been detected from the piezoelectric element, and a sound for identifying a function performed by the external electronic device or the IoT device having a communication connection to the external electronic device.

14. The method of claim 11, further comprising: based on a sound output-related signal being received from the external electronic device through the short-range communication circuit, controlling the at least one switching circuit such that the piezoelectric element and the sound output circuit are electrically connected, and outputting a sound related to the received signal through the sound output circuit, wherein the sound output-related signal comprises a signal requesting a sound output for identifying the position of the electronic device.

15. The method of claim 11, further comprising: based on the touch input not being detected from the piezoelectric element through the touch sensing circuit, configuring a cycle at which the touch input is scanned through the touch sensing circuit to be a first cycle.

16. The method of claim 15, further comprising: based on the touch input not being detected from the piezoelectric element through the touch sensing circuit in a state in which the cycle at which the touch input is scanned through the touch sensing circuit is configured to be the first cycle, configuring the cycle at which the touch input is scanned through the touch sensing circuit to be a second cycle longer than the first cycle.

17. The method of claim 16, further comprising: based on the touch input being detected from the piezoelectric element through the touch sensing circuit in a state in which the cycle at which the touch input is scanned through the touch sensing circuit is configured to be the second cycle, configuring the cycle at which the touch input is scanned through the touch sensing circuit to be the first cycle shorter than the second cycle.

18. The method of claim 11, further comprising: maintaining the electric connection between the piezoelectric element and the sound output circuit based on no connection to an external electronic device being established through the short-range communication circuit.

19. The method of claim 11, further comprising: identifying whether the communication connection to the external electronic device has been released; and based on identifying that the communication connection to the external electronic device has been released, controlling the at least one switching circuit such that the piezoelectric element and the sound output circuit are electrically connected.

20. The method of claim 11, wherein the electronic device comprises a position tracking device mountable on an object.