LETSGO DIGITAL

'SAMSUNG SMARTPHONE HAVING TWO DISPLAY DEVICES AND METHOD OF OPERATING SCREEN THEREOF'

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Samsung Smartphones Linked Magnetically

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BACKGROUND & DESCRIPTION

1. Field

The present disclosure relates generally to an electronic device that attaches or detaches two displays by magnetism and a method of operating a screen thereof.

2. Description of Related Art

Displays are provided in small portable electronic devices as well as in large electronic devices. Generally, a size of a display of an electronic device is restricted by a size of the electronic device. However, with the development of communication and electronic technology, newer trends and/or user needs variously change, and with these changes, displays have evolved in various forms, and various technology developments that extend the display or that enhances use of the display are required.

SUMMARY

The present disclosure is designed to address at least the problems and/or disadvantages described above and to provide at least the advantages described below.

Accordingly, an aspect of the present disclosure is to provide an electronic device that separates into two displays and has a coupling form of various angles, by magnetism, without an external hinge structure. The electronic device may control one or both of two displays to simultaneously output a screen according to the coupling form of two display devices.

In accordance with an aspect of the present disclosure, an electronic device is provided, which includes a first housing including a plurality of surfaces; a first display exposed through one surface of the first housing; a first wireless communication module disposed within the first housing; at least one first cylindrical magnet disposed in at least one end of the first housing and configured to rotate a shaft by attraction of an adjacent magnet; a second housing physically separated from the first housing and including a plurality of surfaces; a second display exposed through one surface of the second housing; a second wireless communication module disposed within the second housing and configured to perform wireless communication with the first wireless communication module; at least one second cylindrical magnet disposed in at least one end of the second

housing and configured to rotate a shaft by attraction of an adjacent magnet; at least one processor disposed in at least one of the first housing and the second housing; and a memory connected to the at least one processor, wherein, when executed, the memory stores instructions that enable the processor to determine a coupling form in which the first housing and the second housing are attached by magnetic attraction of the first cylindrical magnet and the second cylindrical magnet; to select at least one display to display a screen among the first display and the second display according to a coupling form of the first housing and the second housing in response to a screen display request of the display; and to control to output individually or simultaneously a screen in the first display and the second display based on a screen configuration to display in the selected display.

BRIEF DESCRIPTION OF THE DRAWINGS

The objects, features, and advantages of certain embodiments of the present disclosure will be more apparent from the following detailed description in conjunction with the accompanying drawings, in which:

FIG. 1 illustrates an electronic device in a network environment according to an embodiment;

FIG. 2 illustrates a display device according to an embodiment;

FIGS. 3A to 3F illustrate a magnetic coupling structure of two display devices according to an embodiment;

FIGS. 4A to 4C illustrate a magnetic coupling structure of two display devices according to an embodiment;

FIGS. 5A and 5B illustrate a magnetic coupling structure of two display devices according to an embodiment;

FIG. 6 is a flowchart illustrating a method of operating a screen of an electronic device with two detachable displays, by magnetism, according to an embodiment;

FIG. 7 illustrates screen formats of two displays, coupled by magnetism, according to an embodiment;

FIGS. 8 and 9 illustrate screen displays in which a user experience (UX) interface is displayed on an electronic device according to an embodiment;

FIG. 10 is a flowchart illustrating a method of operating two displays coupled by magnetism according to an embodiment;

FIG. 11 illustrates a method of operating a screen of an electronic device including two attachable/detachable displays, by magnetism, according to an embodiment;

FIG. 12 illustrates a method of operating a screen of an electronic device including two attachable/detachable displays, by magnetism, according to an embodiment; and

FIG. 13 illustrates a method of operating a screen of an electronic device including two attachable/detachable displays, by magnetism, according to an embodiment.

DETAILED DESCRIPTION OF EMBODIMENTS

Various embodiments of the present disclosure will now be described in detail with reference to the accompanying drawings. In the following description, specific details such as detailed configuration and components are merely provided to assist the overall understanding of these embodiments of the present disclosure. Therefore, it should be apparent to those skilled in the art that various changes and modifications of the embodiments described herein can be made without departing from the scope and spirit of the present disclosure. In addition, descriptions of well-known functions and constructions are omitted for clarity and conciseness.

The various embodiments and the terms used herein 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.

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.

Further, 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 all possible combinations of the items enumerated together in a corresponding one of the phrases.

Numerical terms, such as "1st," "2nd," "first," and "second" may be used to distinguish a corresponding component from another, but do not limit the components in other aspects (e.g., importance or order). Further, if a first element is referred to as being "coupled with," "coupled to," "connected with," or "connected to" a second element, the first element may be coupled with the second element directly (e.g., wiredly), wirelessly, or via a third element.

Herein, the term "module" may include a unit implemented in hardware, software, or firmware, and may interchangeably be used with other terms, e.g., "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, a module may be implemented as an application-specific integrated circuit (ASIC).

FIG. 1 illustrates an electronic device **101** in a network environment **100** according to an embodiment.

Referring to **FIG. 1**, the electronic device **101** in the network environment **100** may communicate with an electronic device **102** via a first network **198** (e.g., a short-range wireless communication network), or an electronic device **104** or a server **108** via a second network **199** (e.g., a long-range wireless communication network). The electronic device **101** may communicate with the electronic device **104** via the server **108**.

The electronic device **101** includes a processor **120**, memory **130**, an input device **150**, an audio output device **155**, a display device **160**, an audio module **170**, a sensor module **176**, an interface **177**, 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**, and an antenna module **197**. Alternatively, at least one of the components (e.g., the display device **160** or the camera module **180**) may be omitted from the electronic device **101**, or one or more other components may be added in the electronic device **101**. Further, some of the components in the electronic device **101** may be implemented as single integrated circuitry (IC). For example, the sensor module **176** (e.g., a fingerprint sensor, an iris sensor, or an illuminance sensor) may be implemented as an embedded component in the display device **160**.

The processor **120** may execute 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. As at least part of the data processing or computation, the processor **120** may load 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**.

The processor **120** includes a main processor **121** (e.g., a central processing unit (CPU) or an application processor (AP)), and an auxiliary processor **123** (e.g., a graphics processing unit (GPU), 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**.

Additionally or alternatively, 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**.

The auxiliary processor **123** may control at least some of functions or states related to at least one component (e.g., the display device **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). The auxiliary processor **123** 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**.

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

The program **140** may be stored in the memory **130** as software, and may include, e.g., an operating system (OS) **142**, middleware **144**, and an application **146**.

The input device **150** may receive a command or data to be used by other component of the electronic device **101**, from the outside (e.g., a user) of the electronic device **101**. The input device **150** may include a microphone, a mouse, a keyboard, etc.

The audio output device **155** may output sound signals to the outside of the electronic device **101**. The audio output device **155** may include a speaker or a receiver. The speaker may be used for general purposes, such as playing multimedia or playing a record, and the receiver may be used for incoming calls. Alternatively, the receiver may be implemented as separate device, or as part of the speaker.

The display device **160** may visually provide information to the outside of the electronic device **101**. The display device **160** may include a display, a hologram device, or a projector and control circuitry to control a corresponding one of the display, hologram device, and projector. The display device **160** may include touch circuitry adapted to detect a touch, or sensor circuitry (e.g., a pressure sensor) adapted to measure the intensity of force incurred by the touch.

The audio module **170** may convert a sound into an electrical signal and vice versa. The audio module **170** may obtain the sound via the input device **150**, or output the sound via the audio output device **155** or headphones of an external electronic device **102** directly (e.g., wiredly) or wirelessly coupled with the electronic device **101**. 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 generate an electrical signal or data value corresponding to the detected state. For example, the sensor module **176** may include 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, and/or an illuminance sensor.

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 **102** directly (e.g., wiredly) or wirelessly. The interface **177** may include a high definition multimedia interface (HDMI), a universal serial bus (USB) interface, a secure digital (SD) card interface, and/or an audio interface.

A connecting terminal **178** may include a connector via which the electronic device **101** may be physically connected with the external electronic device **102**. The connecting terminal **178** may include an HDMI connector, a USB connector, an SD card connector, and/or an audio connector (e.g., a headphone connector).

The haptic module **179** may convert an electrical signal into a mechanical stimulus (e.g., a vibration or a movement) or electrical stimulus that may be recognized by a user via tactile sensation or kinesthetic sensation. The haptic module **179** may include a motor, a piezoelectric element, and/or an electric stimulator.

The camera module **180** may capture a still image or moving images. The camera module **180** may include one or more lenses, image sensors, image signal processors, and/or flashes.

The power management module **188** may manage power supplied to the electronic device **101**. The power management module **188** may be implemented as at least part of a power management integrated circuit (PMIC).

The battery **189** may supply power to at least one component of the electronic device **101**. The battery **189** may include a primary cell, which is not rechargeable, a secondary cell, which is rechargeable, and/or a fuel cell.

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 electronic device **102**, the electronic device **104**, and/or the server **108**, and may support 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 AP) and supports a direct (e.g., wired) communication or a wireless communication. The communication module **190** includes a wireless communication module **192** (e.g., a cellular communication module, a short-range wireless communication module, and/or a global navigation satellite system (GNSS) communication module) and 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 according to an Infrared Data Association (IrDA) standard) or the second network **199** (e.g., a long-range communication network, such as a cellular 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 multiple 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., an international mobile subscriber identity (IMSI)) stored in the SIM **196**.

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**. The antenna module **197** may include one or more antennas, and, therefrom, 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 by the communication module **190** (e.g., the wireless communication module **192**). 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.

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), and/or mobile industry processor interface (MIPI)).

Commands or data may be transmitted and 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** and **104** may be a same type of device as, or a different type of device from, the electronic device **101**.

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, as at least part of a reply to the request. For example, cloud computing, distributed computing, or client-server computing technology may be used.

An electronic device according to an embodiment may be one of various types of electronic devices. For example, the electronic devices may include a portable communication device (e.g., a smart phone), a computer device, a portable multimedia device, a portable medical device, a camera, a wearable device, or a home appliance, but is not limited thereto.

FIG. 2 illustrates a display device according to an embodiment.

Referring to **FIG. 2**, a display device **260** includes a display **210** and a display driver integrated circuit (DDIC) **230** to control the display **210**. The DDIC **230** includes an interface module **231**, a memory **233** (e.g., a buffer memory), an image processing module **235**, and a mapping module **237**. The DDIC **230** may receive image information including image data or an image control signal corresponding to a command to control the image data from another component of the electronic device **101** via the interface module **231**. For example, the image information may be received from a processor (e.g., the main processor **121** (e.g., an application processor) or the auxiliary processor **123** (e.g., a graphics processing unit) operated independently from the function of the

main processor 121 as illustrated in FIG. 1). The DDIC 230 may communicate with touch circuitry 250 or the sensor module 276 via the interface module 231. The DDIC 230 may also store at least part of the received image information in the memory 233, e.g., on a frame by frame basis.

The image processing module 235 may perform pre-processing or post-processing (e.g., adjustment of resolution, brightness, or size) with respect to at least part of the image data. The pre-processing or post-processing may be performed based at least in part on one or more characteristics of the image data or one or more characteristics of the display 210.

The mapping module 237 may generate a voltage value or a current value corresponding to the image data pre-processed or post-processed by the image processing module 235. The generating of the voltage value or current value may be performed based at least in part on one or more attributes of the pixels (e.g., an array, such as a red, green, blue (RGB) stripe or a pentile structure, of the pixels, or the size of each subpixel). At least some pixels of the display 210 may be driven, based at least in part on the voltage value or the current value, such that visual information (e.g., a text, an image, or an icon) corresponding to the image data may be displayed via the display 210.

The display device 260 further includes the touch circuitry 250. The touch circuitry 250 includes a touch sensor 251 and a touch sensor IC 253 to control the touch sensor 251. The touch sensor IC 253 may control the touch sensor 251 to sense a touch input or a hovering input with respect to a certain position on the display 210. For example, the touch sensor 251 may detect or measure a change in a signal (e.g., a voltage, a quantity of light, a resistance, or a quantity of one or more electric charges) corresponding to the certain position on the display 210. The touch circuitry 250 may provide input information (e.g., a position, an area, a pressure, or a time) indicative of the touch input or the hovering input detected via the touch sensor 251 to the processor 120. At least part (e.g., the touch sensor IC 253) of the touch circuitry 250 may be formed as part of the display 210 or the DDIC 230, or as part of another component (e.g., the auxiliary processor 123) disposed outside the display device 260.

The display device 260 may further include at least one sensor (e.g., a fingerprint sensor, an iris sensor, a pressure sensor, or an illuminance sensor) of the sensor module 276 or a control circuit for the at least one sensor. The at least one sensor or the control circuit for the at least one sensor may be embedded in one portion of a component (e.g., the display 210, the DDIC 230, or the touch circuitry 250)) of the display device 260.

For example, when the sensor module 276 embedded in the display device 260 includes a biometric sensor (e.g., a fingerprint sensor), the biometric sensor may obtain biometric information (e.g., a fingerprint image) corresponding to a touch input received via a portion of the display 210. As another example, when the sensor module 276 embedded in the display device 260 includes a pressure sensor, the pressure sensor may obtain pressure information corresponding to a touch input received via a partial or whole area of the display 210. The touch sensor 251 or the sensor module 276 may be disposed between pixels in a pixel layer of the display 210, or over or under the pixel layer.

FIGS. 3A to 3F illustrate a magnetic coupling structure of two display devices according to an embodiment.

Referring to FIG. 3, an electronic device includes a first electronic device 101 or a first housing 301 and a second electronic device or a second housing 302, which separates from the first housing 301. The second housing 302 may or may not have the same configuration as the first housing 301. The first housing 301 and the second housing 302 may each be individual electronic devices that can perform wireless communication and that can operate independently, but may also be form a single electronic device, wherein two displays are configured with a single set.

The first housing 301 includes a first display 361 having a full screen structure at a front surface and a first cylindrical magnet 310 configured to change, via rotation, positions of an N pole and an S pole by magnetism in at least one end of the first housing 301. The second housing 302 includes a second display 362 having a full screen structure at a front surface and a second cylindrical magnet 312 configured to rotate for magnetic coupling to the first cylindrical magnet 310 included in the first housing 301 in at least one end of the second housing 302.

The first housing 301 may include a fixing portion configured to support the first cylindrical magnet 310 and to

rotate for a shaft change of an N pole and an S pole in response to magnetism of an adjacent magnet. The second housing **302** may also include a fixing portion configured to support the second cylindrical magnet **312** and to rotate for a shaft change of an N pole and an S pole in response to magnetism with an adjacent magnet (e.g., the first cylindrical magnet **310** within the first housing **301**).

When each side surface of the first housing **301** and the second housing **302** that mounts the first cylindrical magnet **310** and the second cylindrical magnet **312** is adjacent and within a predetermined distance of each other, magnetic attraction increases, and thus, the first housing **301** and the second housing **302** may connect through magnetism. For example, when the first housing **301** and the second housing **302** are adjacent, an N pole of the first cylindrical magnet **310** and an S pole of the second cylindrical magnet **312** may rotate accordingly to be in opposite orientation by magnetic attraction, and as the polarities of two cylindrical magnets **310** and **312** are adjusted, the first housing **301** and the second housing **302** may contact and maintain a coupled form.

In order to separate the first housing **301** and the second housing **302**, when the user applies a force that is relatively larger than a magnetic force between the first cylindrical magnet **310** and the second cylindrical magnet **312**, in an opposite direction of a magnetic direction, the first housing **301** and the second housing **302** may be separated from each other.

In order to maintain a coupled form in different orientations of **FIGS. 3A to 3F**, the first housing **301** and the second housing **302** further include holder magnets **311** and **313** at the other side end from which the cylindrical magnets **310** and **312** are disposed. For example, the holder magnets **311** and **313** are disposed at the corners of the other side edges in which the cylindrical magnets **310** and **312** are not disposed. The holder magnets **311** and **313** increase a coupling force of a holding form of the first housing **301** and the second housing **302** and may have a single pole. For example, the holder magnet **311** installed in the first housing **301** and the holder magnet **313** installed in the second housing **302** may have a structure in which a front surface and a rear surface have an opposite pole at an opposite position.

The first housing **301** and the second housing **302** may be magnetically coupled in a form having a predetermined angle, as illustrated in **FIG. 3E**. For example, when a magnetic coupling angle between the first housing **301** and the second housing **302** is changed by a physical force, the first cylindrical magnet **310** and the second cylindrical magnet **312** may rotate within the first housing **301** and the second housing **302**, respectively, to rotate to a position in which opposite polarities maintain maximum attraction. When positions of the S pole and the N pole of the first cylindrical magnet **310** and the second cylindrical magnet **312** rotate, the first housing **301** and the second housing **302** may be magnetically coupled while maintaining a form having a predetermined angle.

As illustrated in **FIG. 3A**, the first housing **301** and the second housing **302** may be magnetically coupled at respective side surfaces in a form in which the first display **361** and the second display **362**face the same direction, e.g., upwards.

Alternatively, the first housing **301** and the second housing **302** may be magnetically coupled at respective side surfaces in a form in which the first display **361** and the second display **362** face different directions, e.g., the first housing **301** and the second housing **302** may be magnetically coupled such that the second display **362** faces downward when the first display **361** faces upward.

The first cylindrical magnet **310** and the second cylindrical magnet **312** each may be a cylinder that can rotate about a single shaft at one side end of at least one of the first and second housings **301** and **302** and may be disposed within a predetermined distance dl from the outside (e.g., the housing) of the housings **301** and **302**. Because the cylindrical magnets **310** and **312** are disposed within a predetermined distance dl, attraction by magnetic coupling between the first housing **301** and the second housing **302** may increase, and by maintaining magnetic attraction, a coupling form of the first housing **301** and the second housing **302** may be variously implemented.

When the first housing **301** and the second housing **302** are magnetically coupled and a force relatively larger than magnetic attraction between the first cylindrical magnet **310** and the second cylindrical magnet **312** is applied in an opposite direction, the first housing **301** and the second housing **302** may be separated from each other, as illustrated in **FIG. 3B**.

Referring to FIG. 3C, the first housing 301 and the second housing 302 may be magnetically coupled in an out-folding form in which the first display 361 and the second display 362 are opposite to each other in an outward direction to both be exposed. For example, the first display 361 is visible on the front surface of the coupled devices and the second display 362 is visible on the rear surface of the coupled devices.

Referring to FIG. 3D, the first housing 301 and the second housing 302 may be attached in an in-folding form in which both the first display 361 and the second display 362 face an inward direction. As illustrated in FIG. 3D, in the in-folding form in which each display is opposite in an inward direction, because the first display 361 and the second display 362 are positioned within the folded housings, the first display 361 and the second display 362 can be protected from an outside environment.

Referring to FIG. 3E, the first display 361 and the second display 362 are exposed in an outward direction, and the first housing 301 and the second housing 302 are magnetically coupled in a coupling angle of 90° or less. In the coupled form of FIG. 3E, because the first housing 301 and the second housing 302 may be supported while maintaining a form having a predetermined angle with a rotation of positions of the S pole and the N pole of the first cylindrical magnet 310 and the second cylindrical magnet 312, the first housing 301 and the second housing 302 may stand on a surface, e.g., a table top, without a separate support.

Referring to FIG. 3F, when the first display 361 and the second display 362 face the same general direction and the first housing 301 and the second housing 302 are attached in a coupling angle of 90° or more, magnetic attraction between the first cylindrical magnet 310 of the first housing 301 and the second cylindrical magnet 312 of the second housing 302 may operate as a relatively larger force than a force of gravity to maintain a magnetic coupling form.

When an electronic device uses one or both the first display 361 and the second display 362 in a coupled form, the electronic device can control a screen output.

The first cylindrical magnet 310 and the second cylindrical magnet 302 included in the first housing 301 and the second housing 302, respectively may be a single cylindrical magnet as a size corresponding to a housing length, direction, or vertical direction. The first cylindrical magnet 310 and the second cylindrical magnet 302 may be a plurality of cylindrical magnets divided into a predetermined size may be disposed based on a size corresponding to a housing length direction or vertical direction. A plurality of cylindrical magnets each may further include a coupling portion coupled to rotate by a single shaft or may have a form in which a plurality of cylindrical magnets are coupled with the same polarity. The plurality of cylindrical magnets may be disposed in a single line at one side end of the first housing 301 and the second housing 302 or may be implemented in a form that can be rotated to be rearranged by attraction of a pole opposite to that of the approaching other magnet.

Alternatively, in order to prevent the first housing 301 and the second housing 302 from being coupled in an alternate form by a repulsive force of the magnet, the first housing 301 and the second housing 302 or an odd-numbered cylindrical magnet may be implemented.

FIGS. 4A to 4C illustrate a magnetic coupling structure of two display devices according to an embodiment.

Referring to FIGS. 4A to 4C, coupling sides of a first housing 401 including a first display 461 and a second housing 402 including a second display 462 are each configured to have three surfaces that are cut in predetermined angles.

For example, in order to improve a magnetic coupling force of cylindrical magnets 410 and 412, side edges of the first housing 401 and the second housing 402 may have an end surface of at least three surfaces. When the side edges are produced in an end surface 40*a* of a first angle, an end surface 40*b* of a second angle, and an end surface 40*c* of a third angle, as illustrated in FIG. 4A, the first display 461 and the second display 462 of the first housing 401 and the second housing 402 may be exposed in an outward direction and be magnetically coupled at the end surfaces 40*c* of the third angle. Therefore, a first cylindrical magnet 410 and a second cylindrical magnet 412 may be rotated to be rearranged with maximum attraction of opposite poles in a contact direction of the end surfaces 40*c* of a third angle. Cutting the end surface of the side edge increases a frictional force of contact surfaces, other than magnetic attraction, in order to improve a fixing force of magnetic coupling

between the first housing **401** and the second housing **402**.

Referring to **FIG. 4B**, the first display **461** and the second display **462** of the first housing **401** and the second housing **402** face in the same direction, and the end surfaces **40***b* of the second angle are coupled in a contact form at the side surfaces of the first housing **401** and the second housing **402**. Accordingly, the first cylindrical magnet **410** and the second cylindrical magnet **412** rotate in a direction of the end surface **40***b* of the second angle, and thus a shaft of magnetic attraction may be changed.

Referring to **FIG. 4C**, the first display **461** and the second display **462** of the first housing **401** and the second housing **402** face in the same direction, and the first end surfaces **40***a* are magnetically coupled in contact form. Because the first end surfaces **40***a* of the first housing **401** and the second housing **402** are coupled in contact form, the first cylindrical magnet **410** and the second cylindrical magnet **412** rotate in a contact direction of the first end surfaces **40***a* to magnetically couple the first housing **401** and the second housing **402**. A contact friction force of the first end surface **40***a* between the first housing **401** and the second housing **402** increases a force of magnetic attraction of the first cylindrical magnet **410** and the second cylindrical magnet **412** to be larger than a force of gravity and a weight of the first housing **401**, thereby improving a fixing force of magnetic coupling between the first housing **401** and the second housing **402**.

Although **FIGS. 4A to 4C** illustrate the side edges cut at three different angles, the side edges of the present disclosure is not limited to this specific shape.

For example, although not illustrated in **FIGS. 4A to 4C**, a side edge in which the first housing **401** and the second housing **402** couple may be formed in a sawtooth shape in addition to an end surface form having an angle. Because an outer shape of the side surfaces of cylindrical magnets disposed at each of the first housing and the second housing is formed in a sawtooth shape of an engaging form, a fixing force of magnetic coupling that couples and supports the first housing **401** and the second housing **402** in a predetermined angle can be improved.

FIGS. 5A and 5B illustrate a magnetic coupling structure of two display devices according to an embodiment.

Referring to **FIGS. 5A and 5B**, a first housing **501** including a first display **561** and a second housing **502** including a second display **562** include a hinge portion **514** for rotatably supporting respective cylindrical magnets **512** and **510** therein.

A first cylindrical magnet **512** disposed within the first housing **501** includes a hinge portion **514** configured to have a plurality of grooves in a sawtooth shape, a protruding portion **515** configured to support the first cylindrical magnet **512** by coupling to the hinge portion **514** and protruded in an engagement form with any one groove of a plurality of grooves included in the hinge portion **514**, a spring **513** configured to adjust elasticity of the protruding portion **515** by curvature of the groove, and an angle adjustment portion **516** configured to adjust a shaft angle of magnetic coupling between the first cylindrical magnet **512** and the second cylindrical magnet **510** by coupling of the hinge portion **514**, the protruding portion **515**, and the groove.

For example, the hinge portion **514** and the angle adjustment portion **516** may be formed in a connected form and may include a cylindrical fixing member (not shown) for connecting and fixing in a separated form. The angle adjustment portion **516** may be fixed to the first housing **501**, and the hinge portion **514** of a sawtooth shape may be rotatably coupled to the angle adjustment portion **516**. When the first cylindrical magnet **512** is adjacent to the second cylindrical magnet **510** and when the first housing **501** and the second housing **502** are disposed at a position having a predetermined angle, the cylindrical magnets **510** and **512** rotate by magnetic attraction to change a shaft direction thereof. Because the hinge portion **514** of a sawtooth form rotates according to a shaft rotation of the magnet, the protruding portion **515** fastened to any one of the grooves of the hinge portion **514** temporarily generates elasticity by the spring **513** to be fastened to the next groove. For example, when the hinge portion **514** rotates, the protruding portion **515** is elastically changed by elasticity of the spring **513**, and a position of the fastened groove may be changed.

Alternatively, the hinge portion may be formed in an internal ball bearing form. For example, the hinge portion may include a plurality of separation prevention protrusions and depressions at an inside of a hole therein and bearings connected to the cylindrical magnet to support rotatably a rotation shaft of the cylindrical magnet, and

a fixing force of magnetic coupling can be improved by coupling of the bearings and the separation prevention protrusions and depressions while rotating by the rotation shaft. Accordingly, even if a coupling angle of the first housing **401** and the second housing **402** is changed in a desired shape, under a user intention, the magnetic shaft is changed to rotate by maximum magnetic attraction within the first housing **401** and the second housing **402**, and by fixing the changed rotation shaft by the hinge portion, a fixing force of magnetic coupling can be improved.

An electronic device according to an embodiment of the present disclosure may control a screen output using one or both the first displays **361**, **461**, and **561** and the second displays **362**, **462**, and **562**according to a coupled form of the first housings **301**, **401**, and **501** and the second housings **302**, **402**, and **502**, respectively.

An electronic device according to an embodiment of the present disclosure may execute at least a partial configuration or function of the first housings **301**, **401**, and **501** and the second housings **302**, **402**, and **502**, according to a coupled form of the first housings **301**, **401**, and **501** and the second housings **302**, **402**, and **502**, respectively. **FIG. 6** is a flowchart illustrating a method of operating a screen of an electronic device in which two displays are attached by magnetism according to an embodiment.

Referring to **FIG. 6**, a processor **120** of an electronic device **101** selects at least one of a first display and a second display, based on at least one of a coupled form of a first housing and a second housing, a disposition direction, executed application information, and execution screen information of the first display and the second display, and controls the selected display to output a screen according to the coupled form of the first housing and the second housing. The processor may be mounted in one or both of the first housing and the second housing. For example, when a plurality of processors exist, one processor may communicate with other processors through the wireless communication unit, thereby comprehensively controlling components included within each housing.

At step **610**, at least one processor receives an event that requests to turn-on a display. For example, the processor may receive an input event that requests to turn-on the display. The input event may be received from the user through a touch input, a button input, or a voice input. Alternatively, the processor may receive notification information to detect an occurrence of a notification event that outputs the notification information to the display.

At step **620**, the processor obtains sensing information from a sensor module in response to the turn-on request of the display. The sensor module mounted in the first housing and/or the second housing may include at least one of a sensor, a gyro sensor, a geomagnetic sensor, a gravity sensor, a motion sensor, an inclination sensor, a brightness sensor, an altitude sensor, a smell sensor, a temperature sensor, a depth sensor, a pressure sensor, a bending sensor, an audio sensor, a video sensor, a GPS sensor, and a touch sensor.

At step **630**, the processor determines a coupled form by attraction of cylindrical magnets mounted in each of the first housing and the second housing, based on sensing information obtained from the sensor module.

The processor may determine the coupled form of the first housing and the second housing, a position direction of the first display positioned at the first housing and the second display positioned at the second housing, and a display position that recognizes the user through sensing information.

At step **635**, the processor obtains execution screen information or application execution information to output to the display. For example, the user may request execution of a specific application or may input a screen change request of the executed application through the input module.

At step **640**, the processor determines a display to display information according to a determined coupled form of the displays and determines division information and a size of a screen for outputting information in the operation.

For example, as illustrated in **FIG. 3A**, when side surfaces of the first housing and the second housing contact with each other and the first display **361** and the second display **362** face in the same direction, the processor may recognize the coupled form of the first housing **361** and the second housing **362**. Because the first display **361** and the second display **362** are face the same direction, e.g., a direction facing the user, the processor may determine both the first display **361** and the second display **362** to display information, and may

determine at least one of a configuration and a size of a screen to be output to each of the first display and the second display and division information.

At step **650**, the processor controls to output a screen in at least one display determined based on at least one of the determined screen configuration, screen size, and division information.

For example, when the user requests movie reproduction, if two housings are in a magnetic coupled form as illustrated in **FIG. 3A**, the processor may divide screen output information of movie reproduction to control to output the screen output information in both the first display **361** and the second display **362**. Accordingly, the electronic device may provide a visual effect of viewing the movie on a larger screen by simultaneously using the first display **361** and the second display **362** as one screen. The processor mounted in any one of the first housing and the second housing may perform the above-described operations and perform wireless communication through a wireless communication module included in each of the first housing and the second housing in order to transmit and receive a screen control command of the display and data of screen information. For example, the processors for controlling the first display and the second display may independently operate in each of the first housing and the second housing, and a main processor mounted in any one of the first housing and the second housing may operate to transfer a control command of the display to each display driver IC for controlling the display.

FIG. 7 illustrates screen formats of two displays, coupled by magnetism, according to an embodiment.

Referring to **FIG. 7**, an electronic device may determine a coupled form by magnetic attraction between two housings, adjust a screen size, and divide a screen according to the coupled form in order to output at least one of a first display and a second display.

As shown in screen format **701**, when outputting a home screen in the display, an electronic device may display a home screen of a first page in a first display and display a home screen of a second page in a second display. When a page change input is detected by the user, the electronic device may display a home screen of a third page in the first display and/or to display a home screen of a fourth page in the second display.

As shown in screen format **702**, the electronic device may select only one of a first display and a second in order to display information according to the coupled form and output an execution screen on only the selected display.

As shown in **FIG. 3C**, when only one of the first display and the second display is positioned in a direction facing the user, the electronic device may control to display an execution screen in only the display facing the user, e.g., the second display **362**.

As shown in screen format **703**, when an event to output information derived from an execution screen is detected while outputting an execution screen in only the first display, the electronic device output derived information, e.g., a secondary screen in the second display. For example, when the user requests a search for a specific keyword through a web page screen output on the first display, the processor output a search screen of the results for a specific keyword on the second display.

As shown in screen format **704**, the electronic device may output different screens on the first display and the second display. For example, the electronic device may output a first app execution screen on the first display and output a second app execution screen on the second display.

As shown in screen format **705**, the electronic device may divide screen information for display as a single image on both the first display and the second display. For example, the electronic device may divide screen output information of movie reproduction to output the screen output information in both the first display and the second display.

FIGS. 8 and 9 illustrate screen displays in which a UX interface is displayed on an electronic device according to an embodiment.

Referring to **FIG. 8**, by cooperating a first display and a second display according to a coupled state of a first housing **801** and a second housing **802**, a processor of an electronic device may simultaneously output a first

screen and a second screen or output a second screen derived from a first screen.

In order for two displays to face the user, the user may change a magnetic coupling form of the first housing **801** and the second housing **802** and perform a request input that turns on the display. The processor of the electronic device may output screens in both the first display and the second display in response to the request input that turns on the display.

For example, the processor of the electronic device may display a home screen **811** in the first display of the first housing **801** and display a secondary screen **812** in the second display of the second housing **802**. Here, the secondary screen may include at least one of notification information that provides notification information to a user, news information, use information of a housing that analyzes and provides a user's life pattern, frequently used app information, and user setting information.

For example, the processor of the electronic device may output an execution screen in both the first display and the second display in a coupled state in which a first display and a second display are contacted at respective side surfaces, e.g., as illustrated in **FIGS. 3A, 3E, and 3F**, or may output one screen, i.e., a screen using one display of the first display and the second display in an out folding state in which the displays are exposed on opposite sides of the coupled device, as illustrated in **FIG. 3C**.

Referring to **FIG. 9**, the user may use a first app execution screen **911** output on the first display of the first housing **901**. For example, when the first app execution screen **911** is a web page, the user may request a search for a specific keyword of the web page. The processor of the electronic device may determine a magnetic coupling form in which the first display and the second display are exposed in the same direction and contacted at side surfaces thereof, and output a search result screen **912** for a search keyword in the second display of the second housing **902**.

When the user surfs a web page through the first display, the user may receive information about advertisement pop-up derived from a currently output web page.

Therefore, the processor of the electronic device may determine a magnetic coupling form in which the first display and the second display are exposed in the same direction and contacted at side surfaces thereof, and output an advertisement pop-up screen on the second display.

FIG. 10 is a flowchart illustrating a method of operating a screen of two displays coupled by magnetism according to an embodiment.

Referring to **FIG. 10**, at step **1010**, at least one processor detects an input that requests camera-on. For example, when the processor receives a user input (e.g., a touch or voice input) that requests camera app execution or receives a change signal that changes from a magnetic coupling form in which the first display and the second display are opposite to each other and are exposed to the outside to a coupling form that slides to expose a portion of rear surfaces of the first housing and the second housing, the processor may detect an input that requests camera-on.

At step **1030**, the processor outputs a camera image obtained from the camera module (e.g., the image sensor **180**).

The processor may enter a camera mode and output a camera image to the first display in response to the change signal that changes from a magnetically coupled form in which the first display and the second display are opposite to each other and are both exposed to a coupled form in which a portion of the rear surfaces of the first housing and the second housing are exposed, but the present disclosure is not limited thereto and the processor may output a camera image obtained from the camera module to the second display opposite to the first display.

For example, when the user wants to take a picture of a person, the user may view an image of person through a camera image output on the first display and the person may view their image through the camera image output on the second display.

At step **1035**, the processor detects a change in a disposition direction of the first display and the second

display, e.g., a direction rotation.

At step **1040**, the processor outputs a camera image on the second display in response to the change in the disposition direction of the first display.

Alternatively, the processor may detect that a magnetically coupled form of the first housing and the second housing has been changed or may detect a movement in which a disposition direction of the first display is rotated such that the camera sensor faces the user.

FIG. 11 illustrates a method of operating a screen of an electronic device including two displays, attached by magnetism, according to an embodiment.

Referring to **FIG. 11**, a user may change from a magnetically coupled form in which a first display **1161** and a second display **1162** are even folder on each other by sliding a first housing **1101** and a second housing **1102** to expose a portion of the rear surfaces of the first housing **1101** and the second housing **1102**.

When a change signal is detected by sliding the first housing **1101** and the second housing **1102** to expose the portion of rear surfaces of the first housing **1101** and the second housing **1102**, the electronic device may enter a camera execution mode and output a camera image obtained from a camera module **1180** to the first display **1161**.

The electronic device may simultaneously output a camera image obtained from the camera module to the first display and the second display.

Thereafter, the user may rotate a display direction of the first housing **1101** and the second housing **102** such that the second display **1162** and the camera module **1180** face the user in a coupling form that slides to expose a portion of rear surfaces of the first housing **1101** and the second housing **102**.

The electronic device may output a camera image obtained from the camera module **1180** on the second display **1162**. For example, the camera module **1180** may obtain a user image, and the user may determine the user's selfie image through the second display **1162** facing the user.

FIG. 12 illustrates a method of operating a screen of an electronic device including two displays, attached by magnetism, according to an embodiment.

Referring to **FIG. 12**, a user may operate the electronic device in a form in which a first display **1261** and a second display **1262** are exposed in the same direction and in which a first housing **1201** and a second housing **1202** are magnetically coupled at the side surfaces thereof. Accordingly, the electronic device may output a large screen through the first display **1261** and the second display **1262**.

Thereafter, if the user wants to take a selfie, the user may flip the first housing **1201** to change to the magnetically coupled form, such that the first display **1261** is opposite to the second display **1262**and a camera module **1280** faces the user in the same direction as the second display **1262**.

Therefore, the electronic device may recognize that a disposition position of the first display **1261** has been changed by a rotation and control to output the user's camera image obtained through the camera module to the second display **1262**.

FIG. 13 illustrates a method of operating a screen of an electronic device including two displays, attached by magnetism, according to an embodiment.

Referring to **FIG. 13**, in a first magnetically coupled form, a first display **1361** and a second display **1362** are disposed in the same direction, such that a rear surface of a first housing **1301** covers a front surface of a second housing **1302**.

If the user wants to display a message writing screen or a text input screen, the user may slide the first housing **1301** upward to expose a portion of the second display **1362** of the second housing **1302**.

The electronic device may detect the sliding operation and output a text input screen or a document input screen. The electronic device may detect a size of portion of the second display **1362** exposed to the outside and control to output a touch key pad screen for a touch input to the second display **1362** to correspond to the exposed size.

According to an embodiment of the present disclosure, an electronic device having two displays includes cylindrical magnets that can rotate to change shaft directions of the magnets at side surfaces thereof, and couple the two displays in various angles by rotating shafts of the magnets by magnetic attraction of an adjacent magnet.

The electronic device can determine a coupled form of two displays, coupled by magnetic attraction, select at least one of the two displays to display a screen according to the coupled form and screen output information, and output an optimal screen in the selected display.

Accordingly, a user can change output information of a screen by changing a coupled form of two displays, and thus, the user's UX experience convenience and usability of electronic devices can be improved.

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 **120** of the machine 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.

Accordingly, the machine may be operated to perform at least one function according to the at least one instruction invoked.

The one or more instructions may include a code generated by a complier or a code executable by an interpreter. The machine-readable storage medium may be provided in the form of a non-transitory storage medium. Herein, the term "non-transitory" means that the storage medium is a tangible device, and does not include a signal (e.g., an electromagnetic wave), but this term does not differentiate between where data is semi-permanently stored in the storage medium and where the data is temporarily stored in the storage medium.

A method according to an embodiment 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., Play Store™), 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. According to the above-described embodiments, each component (e.g., a module or a program) may include a single entity or multiple entities. Alternatively, 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, 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 an embodiment, operations performed by a module, a 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.

Although certain embodiments of the present disclosure have been described in detail hereinabove, it should be clearly understood that many variations and modifications of the basic inventive concepts herein described, which may appear to those skilled in the art, will still fall within the spirit and scope of the embodiments of the present disclosure as defined in the appended claims and their equivalents.