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(54) **MAGNETIC CONTROLLER FOR DEVICE CONTROL**

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(51) **Int. Cl.**

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G06F 1/16	(2006.01)
G06F 3/02	(2006.01)
G06F 3/038	(2013.01)

(Continued)

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

CPC ***G01R 33/02*** (2013.01); ***A63F 13/21*** (2014.09); ***G01R 33/093*** (2013.01); ***G01R 33/096*** (2013.01); ***G05G 9/047*** (2013.01); ***G06F 1/1632*** (2013.01); ***G06F 1/1694*** (2013.01); ***G06F 3/0202*** (2013.01); ***G06F 3/038*** (2013.01); ***G06F 3/0338*** (2013.01); *G05G 2009/04755* (2013.01)

(58) **Field of Classification Search**

None

See application file for complete search history.

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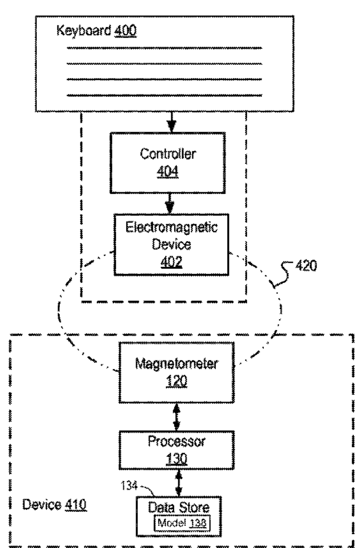
Primary Examiner — Kirk W Hermann

(57) **ABSTRACT**

Systems, methods and apparatus for using a magnetic controller to control a device. In one aspect, a system includes a magnetic controller external to a device, the magnetic controller including: a magnetic device for altering a surrounding magnetic field of a device; one or more input actuators, each operatively coupled to the magnetic device and that when actuated cause the magnetic device to alter the surrounding magnetic field according to a predefined change associated with the input actuator; and a model executable by the device and that models as device inputs the differences in the surrounding magnetic field of the device caused by the actuation of the one or more input actuators.

20 Claims, 4 Drawing Sheets



Related U.S. Application Data

(60) Provisional application No. 62/016,392, filed on Jun. 24, 2014.

(51) **Int. Cl.**

G01R 33/09	(2006.01)
G05G 9/047	(2006.01)
G06F 3/0338	(2013.01)
A63F 13/21	(2014.01)

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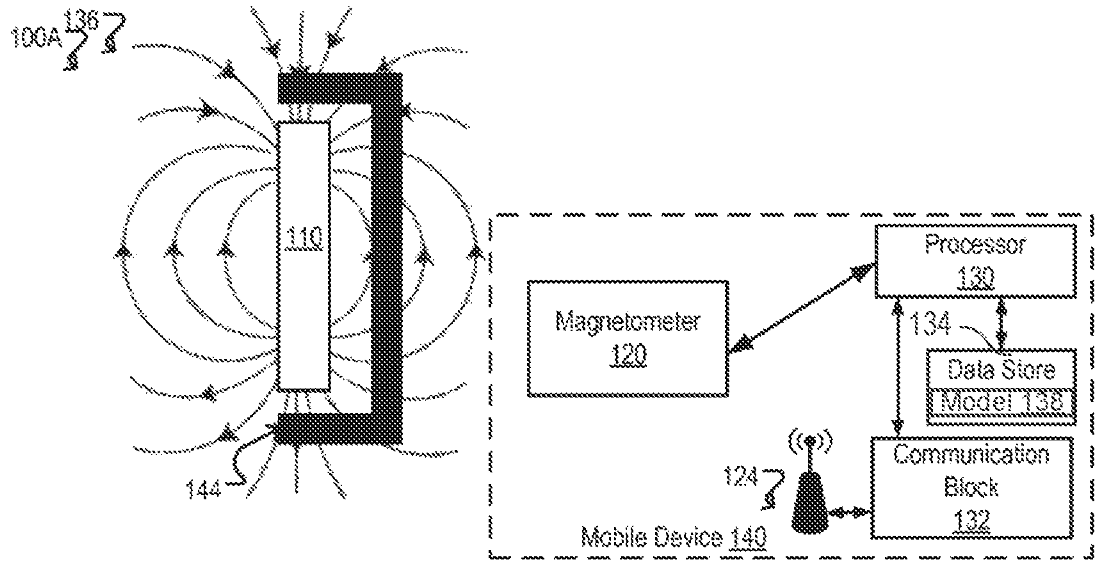
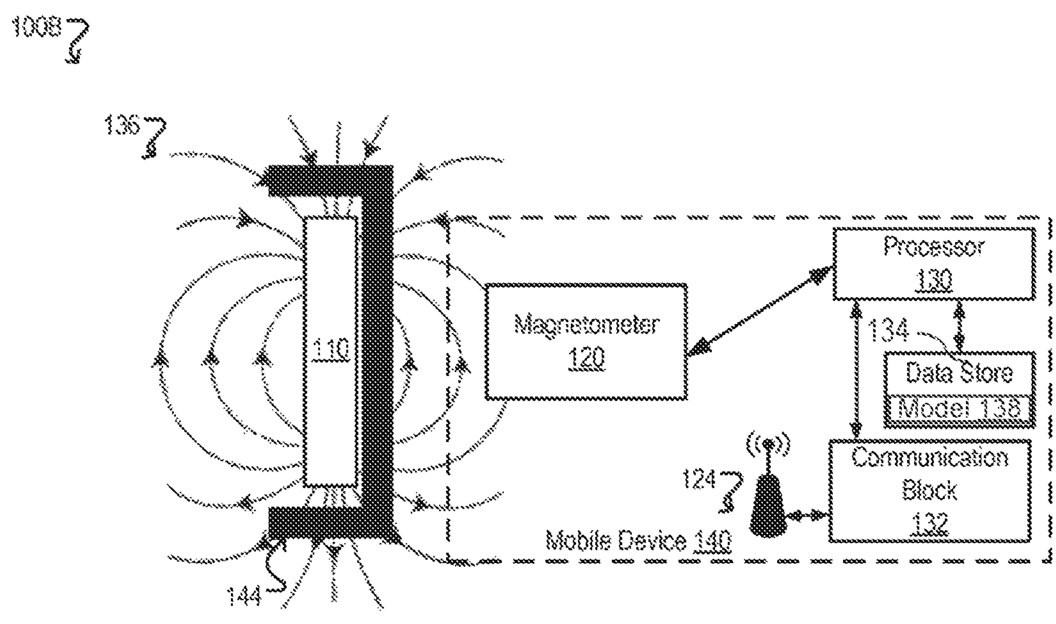

100A
136
110
144
Magnetometer
120
Processor
130
134
Data Store
Model 138
Communication
Block
132
124
Mobile Device 140

FIG. 1A


100B
136
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Magnetometer
120
Processor
130
134
Data Store
Model 138
Communication
Block
132
124
Mobile Device 140

FIG. 1B

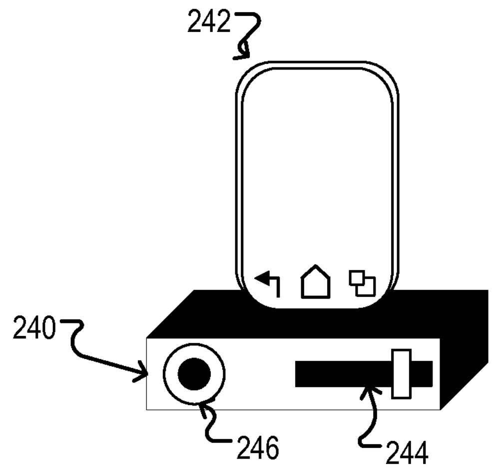

FIG. 2A

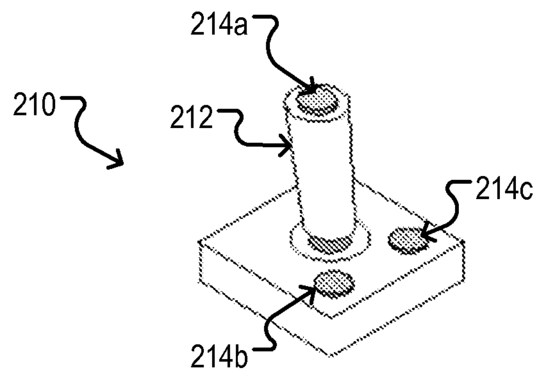

FIG. 2B

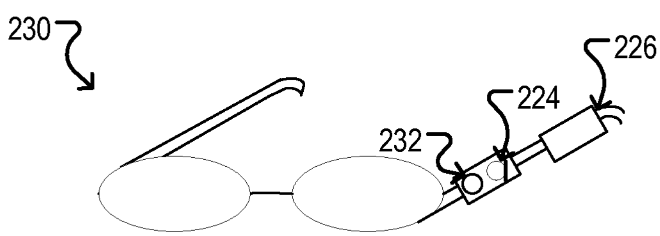

FIG. 2C

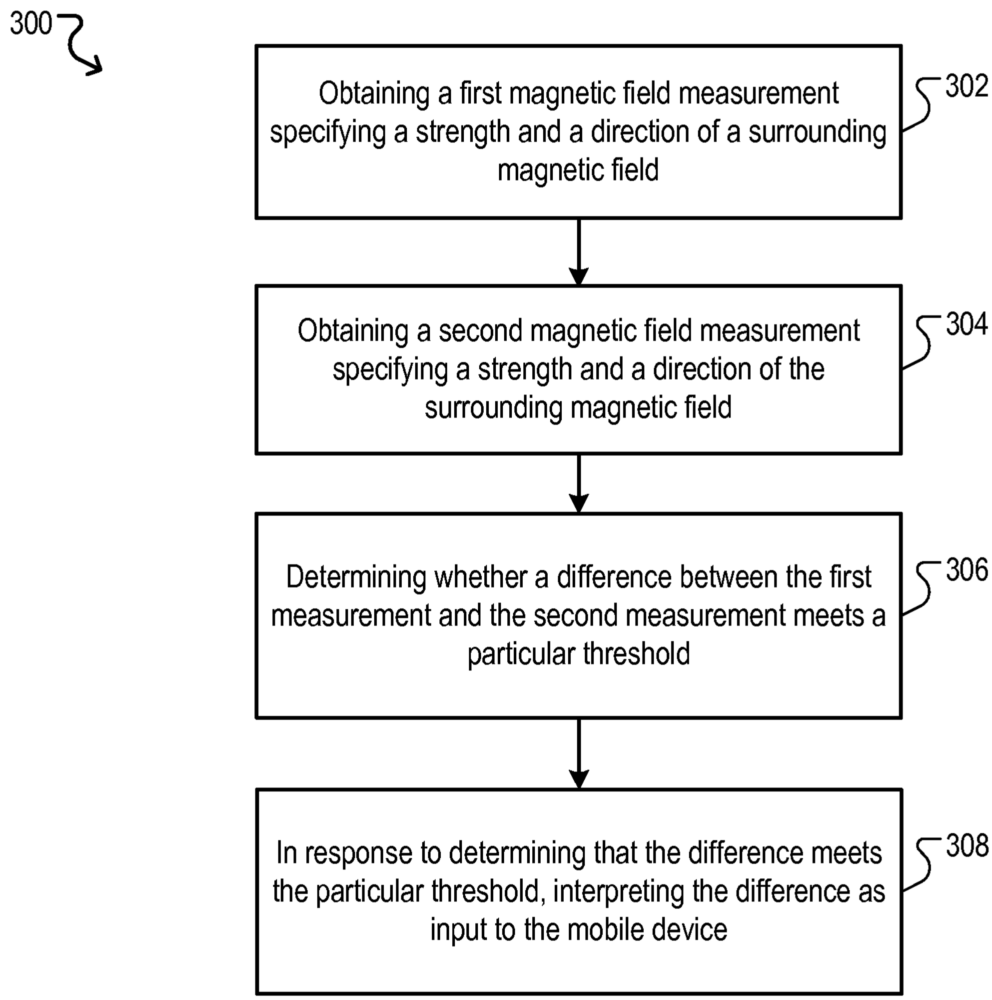
300
Obtaining a first magnetic field measurement specifying a strength and a direction of a surrounding magnetic field
302
Obtaining a second magnetic field measurement specifying a strength and a direction of the surrounding magnetic field
304
Determining whether a difference between the first measurement and the second measurement meets a particular threshold
306
In response to determining that the difference meets the particular threshold, interpreting the difference as input to the mobile device
308

FIG. 3

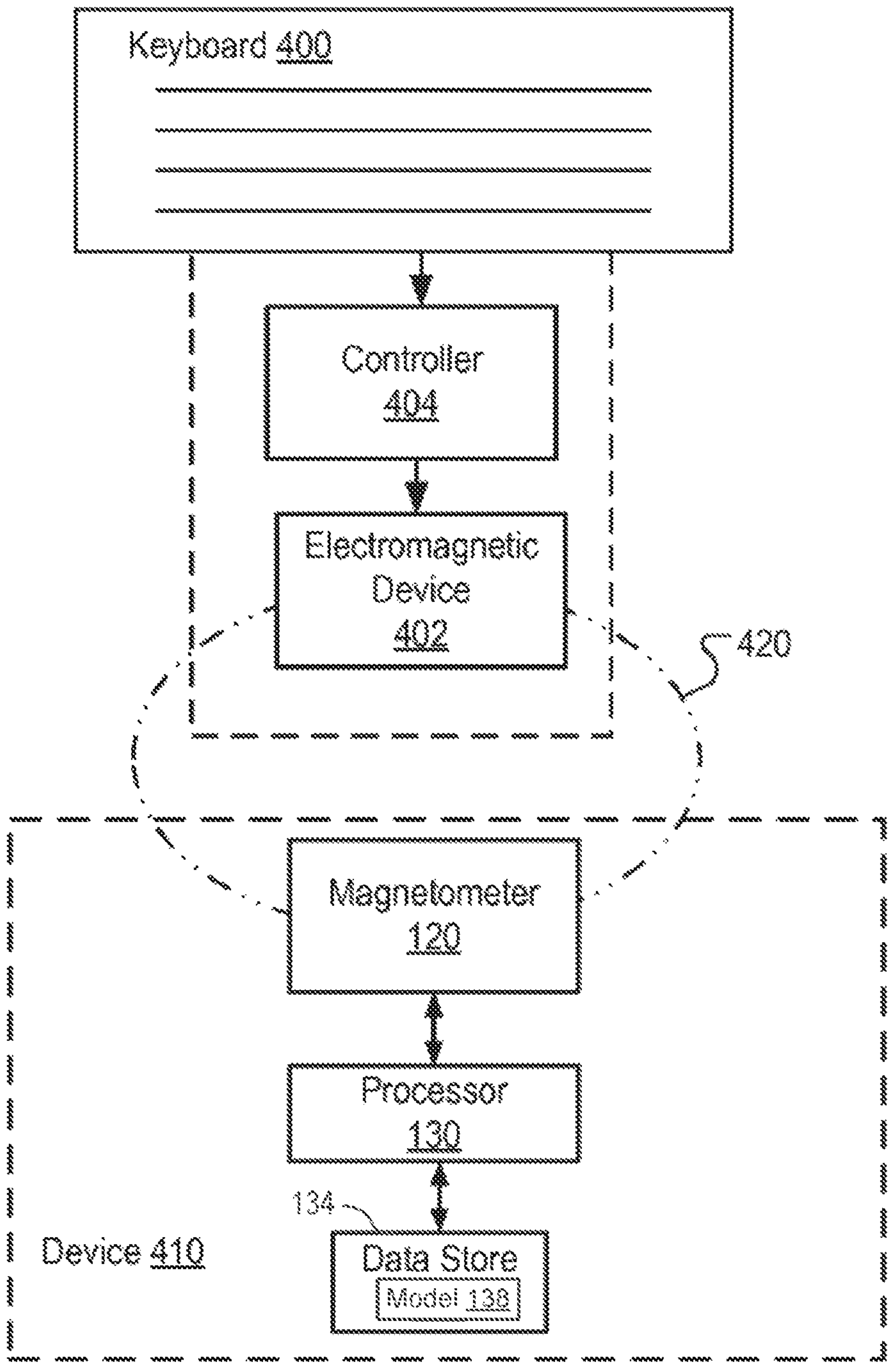
Keyboard 400
Controller 404
Electromagnetic Device 402
420
Magnetometer 120
Processor 130
134
Device 410
Data Store
Model 138

FIG. 4

MAGNETIC CONTROLLER FOR DEVICE CONTROL

CROSS-REFERENCE TO RELATED APPLICATIONS

This application claims the benefit under 35 U.S.C. § 119(e) of U.S. Patent Application No. 62/016,392, titled "Magnetic Controller For Device Control," filed Jun. 24, 2014. The disclosure of the foregoing application is incorporated herein by reference in its entirety for all purposes.

BACKGROUND

Mobile devices are currently one of the most popular types of electric devices. For example, cellular phones continue to expand their domain of connectivity to allow users to access their email, and music, as well as play games on their cellular phones. Likewise, tablet computers are designed with a convenient form factor that supports ease of portability. Since mobile devices became an integral part of everyday life, many applications are now available for mobile devices.

Many of these applications, and the mobile device itself, can be controlled using touch screen controls or buttons on the mobile device. Furthermore, many mobile devices can mate with peripheral docks, such as a dock with a keyboard and other controls, to allow the user utilize a larger input device for the mobile device when convenient, e.g., when sitting down and not moving about.

Many mobile devices are now often equipped with a magnetometer that allows the devices to detect the surrounding magnetic field. The magnetometer is traditionally used to provide a digital compass on the mobile device.

SUMMARY

This specification relates to a magnetic controller for data input. In particular, the specification relates to utilizing a magnetometer of a user device, such as a smart phone or table, or even a desk top computer is the computer is so equipped, to interpret magnetic field changes caused by the magnetic controller as input.

In general, one innovative aspect of the subject matter described in this specification can be embodied in a method including the actions of determining, by a magnetometer of a device, a reference magnetic field measurement, the reference magnetic field measurement specifying a strength and a direction of a surrounding magnetic field that surrounds the magnetometer; determining, by the magnetometer of a device, a series of subsequent magnetic field measurements, each subsequent magnetic field measurement specifying a strength and a direction of a surrounding magnetic field that surrounds the magnetometer; for each subsequent magnetic field measurement: determining, by a processor of the device, a difference between the reference magnetic field measurement and the subsequent magnetic field measurement, determining, by the processor of the device, whether the difference between the reference magnetic measurement and the subsequent magnetic field measurement meets a threshold change; for each difference that does not meet the threshold change, not interpreting the difference as a user input to the device; and for each difference that does meet the threshold change, determining, based on an input model that models differences in the surrounding magnetic field for a plurality of user inputs, a user input to the device.

Another innovative aspect of the subject matter described in the specification can be embodied in a system including a magnetic controller external to a device, the magnetic controller including: a magnetic device for altering a surrounding magnetic field of a device; one or more input actuators, each operatively coupled to the magnetic device and that when actuated cause the magnetic device to alter the surrounding magnetic field according to a predefined change associated with the input actuator; and a model executable by the device and that models as device inputs the differences in the surrounding magnetic field of the device caused by the actuation of the one or more input actuators. Another innovative aspect of the subject matter described in the specification can be embodied in a system including a data processing apparatus including a processing subsystem and a magnetometer, the data processing apparatus operable to: determine, by the magnetometer, a reference magnetic field measurement, the reference magnetic field measurement specifying a strength and a direction of a magnetic field that surrounds the magnetometer; determining, by the magnetometer, a series of subsequent magnetic field measurements, each subsequent magnetic field measurement specifying a strength and a direction of a surrounding magnetic field that surrounds the magnetometer; for each subsequent magnetic field measurement: determining, by the processing subsystem, a difference between the reference magnetic field measurement and the subsequent magnetic field measurement, determining, by the processing subsystem, whether the difference between the reference magnetic measurement and the subsequent magnetic field measurement meets a threshold change; for each difference that does not meet the threshold change; not interpreting the difference as a user input to the data processing apparatus; and for each difference that does meet the threshold change; determining, based on an input model that models differences in the surrounding magnetic field for a plurality of inputs, a user input to the data processing apparatus; and magnetic controller external to the data processing apparatus, the magnetic controller including: a magnetic device for altering the surrounding magnetic field; one or more input actuators, each operatively coupled to the magnetic device and that when actuated cause the magnetic device to alter the surrounding magnetic field according to a predefined change associated with the input actuator.

Another innovative aspect of the subject matter described in the specification can be embodied in a method including determining, by a magnetometer of a device, a transient variation in a magnetic field; determining, by the processor of the device, whether the transient variation in the magnetic field meets a threshold change; for each transient variation that does not meet the threshold change, not interpreting the transient variation an input to the device; and for each transient variation that does meet the threshold change, determining, based on an input model that models transient variations in the surrounding magnetic field to a plurality of inputs, each transient variation uniquely corresponding on a corresponding input, a user input to the device.

Another innovative aspect of the subject matter described in the specification can be embodied in a system including a magnetic controller external to a device, the magnetic controller including: an electromagnetic device for altering a surrounding magnetic field of a device; a plurality of input actuators, each operatively coupled to a controller and that generate a user input signal for the controller, and wherein the controller generates, for each input signal, a correspondingly unique signal to drive the electromagnetic device to generate a transient variation in the magnetic field that

uniquely corresponds to the input; and a model executable by the device and that models as device inputs the transient variation in the surrounding magnetic field of the device caused by the actuation of the one or more input actuators.

Particular embodiments of the subject matter described in this specification can be implemented so as to realize one or more of the following advantages. The systems described in this specification allow devices to interpret commands from magnetic controllers. The magnetic controllers may be either passive or active. Passive controllers do not require nor consume power. Active controllers may be easier to calibrate and optimize relative to a passive controller for optimization with a particular device.

The magnetic controller allows wireless control of mobile devices and need not conform to proprietary or standardized communication protocols. Finally, the magnetic controller does not require alteration of the hardware of controlled devices that include magnetometers.

The details of one or more embodiments of the subject matter described in this specification are set forth in the accompanying drawings and the description below. Other features, aspects and advantages of the subject matter will become apparent from the description, the drawings and the claims.

BRIEF DESCRIPTION OF THE DRAWINGS

FIGS. **1**A and **1**B are block diagrams of an example implementation of a system including a passive wireless magnetic controller for a device.

FIGS. **2**A-**2**C are block diagrams of different types of magnetic controllers.

FIG. **3** is a flow chart of an example process for controlling a device equipped with a magnetometer using a magnetic controller.

FIG. **4** is a block diagram of an example multi-input device with an electronically controlled electromagnetic device.

Like reference numbers and designations in the various drawings indicate like elements.

DETAILED DESCRIPTION

The subject matter below relates to systems and methods where magnetic controllers are used in combination with a user device to control the user device. In the examples below, the magnetic controller is described in the context of a mobile device. However, the principals of the magnetic controller can be used for other devices that have magnetometers, such as wearable devices, tablet devices, and event desktop and tablet devices.

FIGS. **1**A and **1**B are block diagrams of an example implementation of a system **100**A **100**B that includes a magnetic controller **144** for a device, such as a mobile device **140**. In the example shown, the magnetic controller **144** is a button actuator, and is external to the mobile device **140**.

The mobile device **140** includes a magnetometer **120** in communication with the processor **130**. The magnetometer generates magnetic field measurements periodically or in response to a request by processor **130**. These series of magnetic field measurements may be represented as a series of space vectors, each vector having a magnitude value and a direction value. The direction value may be a 3-dimensional direction in a 3-dimensional space.

The processor **130** performs calculations and processes data received from different components of the mobile device **140**. For example, the processor **130** is in communication with communication block **132** and magnetometer **120**. The communication block **132** is responsible for transmitting and receiving data through wireless transceiver **124**. The wireless transceiver **124** is connected to communication block **132** and is capable of transmitting as well as receiving signals.

The mobile device **140** also includes a data store **134** that stores instructions, applications and the like that are executable by the processor **130**. As will be described in more detail below, the data store **134** stores an input model **138** that models differences in the surrounding magnetic field for a plurality of user inputs. The processor **130** compares the magnetic field measurements, determines changes relative to a reference magnetic field measurement, and consults the model **138** to determine a corresponding user input to the mobile device.

In some implementations, the input model **138** may be a machine learned classifier. The classifier may be trained with positive and negative data samples, where positive data samples are corresponding to an input being actuated (e.g., a button being pressed), and negative data samples correspond to an input not being actuated. The model is then learned based on the data samples. For example, with reference to FIGS. **1**A and **1**B, a first set of measurements at magnetometer **120** are obtained when the magnet **110** is not depressed. The first set corresponds to negative data samples. Similarly, a second set of measurements at the magnetometer **120** when the magnet **110** is pressed are obtained and correspond to positive data samples. The first and second sets of measurements at magnetometer **120** may be used to train the machine learning classifier to differentiate between measurements obtained for the magnet **110** being pressed and the magnet **110** not being pressed.

In some implementations the classifier may be trained in an environment containing a specific amount of interference. For example, a nominal background magnetic field may be determined from a variety of environments, and may be induced when training the classifier.

Additional sets of measurements may be used to train more complex models. For example, a device with multiple inputs, e.g., multiple buttons and a joystick, may be capable of generating multiple different sets of data—various combinations of button actuations and joystick positions—to train a model to determine the different combinations.

In FIG. **1**A, the magnetic controller **144** has a magnet **110** positioned in a first position. For example, the magnet **110** may be integrated into a keyboard key. When the magnet **110** is not depressed as shown in FIG. **1**A, the magnetic field **136** produced by the magnet generated by the magnet is relatively weak at the area surrounding magnetometer **120**. However, when the magnet **110** is depressed, as shown in FIG. **1**B, it is displaced closer to the magnetometer **120**. Moving the magnet **110** to this second position causes the magnetic field **136** to be stronger at the area surrounding magnetometer **120** than when the magnet was not depressed.

The processor **130** receives the readings of the magnetometer **120** and can differentiate between the magnetic fields produced when magnet **110** is in the first position and when magnet **110** is in the second position. For example, the readings provided by the magnetometer are transferred to processor **130**. In turn, the processor **130** interprets the magnet being in the first and second position as different inputs, based on the magnetic field produced by the magnet in each position.

In operation, the magnetometer **120** of the device **140** generates a reference magnetic field measurement. The reference magnetic field measurement specifies strength and a direction of a surrounding magnetic field that surrounds the magnetometer **120**. For example, when a user desires to use the magnetic controller **144**, software on the mobile device **140** may take a reference reading of the magnetic field. This reference reading is then used to determine differences in the magnetic field caused by the magnetic controller **144**.

The magnetometer **120** then provides a series of subsequent magnetic field measurements to the processor **130**. Each subsequent magnetic field measurement specifies strength and a direction of a surrounding magnetic field that surrounds the magnetometer **120**. For each subsequent magnetic field measurement, the processor **130** determines a difference between the reference magnetic field measurement and the subsequent magnetic field measurement, and then determines whether the difference between the reference magnetic measurement and the subsequent magnetic field measurement meets a threshold change. The threshold change can be used to ensure that minor disturbances in the magnetic field are not interpreted as user inputs, and that changes in orientation of the device in an ambient magnetic field (e.g., Earth's magnetic field) are also not interpreted as user inputs. Accordingly, the threshold change can selected to distinguish between an orientation change in the user device where the ambient magnetic field is relatively undisturbed, and an induced change to the magnetic field by a control device, where the induced change significantly alters the surrounding ambient magnetic field. The induced changes can thus be mapped to a user input control model.

In some implementations, the threshold change can be selected based on the magnetic controller type. For example, a magnetic controller may, by use of magnets, cause at least a minimum change in the magnetic field surrounding the magnetometer **120** when the magnetic controller is used as specified (e.g., within a certain distance of the device **140**). The threshold is selected to be slightly less than the minimum change, and is stored in a model that is generated for the magnetic controller **144**.

For each difference that does not meet the threshold change, the processor **130** does not interpret the difference as an input to the mobile device **140**. Conversely, for each difference that does meet the threshold change, the processor **130** determines a corresponding input based on an input model that models differences in the surrounding magnetic field for a plurality of inputs.

In some implementations, the model **138** can be provided with software that accompanies the magnetic controller **144**. The model **138** can describe a mapping of the magnetic field changes to inputs supported by the magnetic controller **144**. The mapping can be determined, for example, by the manufacturer of the magnetic controller **144**. In other implementations, the processor **130** can execute a learning program that prompts the user to perform inputs using the magnetic controller **144**, and then monitors the changes in the magnetic field. These changes are then stored in the data store **134** as the input model **138**.

Other types of magnetic controllers other than the controller of FIG. **1** can be used. For example, FIGS. **2**A-**2**C are block diagrams of different types of magnetic controllers.

FIG. **2**A illustrates one type of magnetic controller that is a magnetic dock **240** that receives a mobile device **242**. In some implementations, magnetic dock **240** is a passive magnetic dock that includes one or more magnets that are respectively connected to one or more actuators. In an alternate implementation, the dock **240** may be an active dock that is powered and in which the actuators are connected to a processing system that, in turn, drives one or more electromagnets to manipulate a magnetic field in response to activation of the actuators.

The magnetic dock **240** may include one or more input actuators. For example, magnetic dock **240** may include a magnetic slider **244** and a magnetic knob **246**. In one implementation the magnetic slider **244** may be used to control the volume of the mobile device **242** while knob **246** may be used to control navigation of the mobile device.

Both actuators **244** and **246** are each operatively coupled to a magnetic device and when actuated cause the magnetic device to alter the surrounding magnetic field according to a predefined change associated with the input actuator.

The mobile device **242** may detect placement in dock **240**. In one implementation mobile device **242** detects placement in dock **240** by determining the mobile device orientation. For example, if dock **240** is designed to hold the mobile device vertically 15 degrees from an upright position, when the mobile device **242** determines that its orientation is vertical and 15 degrees from an upright position, the mobile device **242** may determine that it is in the dock **240**. In another implementation, the mobile device **242** determines its orientation using magnetometer **120** and sensing for a reference magnetic field that may be present when mounted in the dock **240**. When the processor **130** determines the mobile device **242** is in the dock **240**, it will interpret the changes in the magnetic fields as commands; however, if the mobile device **242** is not within the dock **240**, the processor **130** will not interpret the changes in the magnetic fields as commands.

The dock **240** may be implemented as a passive magnetic dock. Operating control elements, such as slider **244** and knob **246**, may cause mechanical displacements of magnets within the dock **240**. Moving magnets within dock **240** causes alteration of a magnetic field surrounding mobile device **242**. As described above, the magnetometer **120** detects changes to the surrounding magnetic field and interprets such changes as input to the mobile device **242**. Moving the slider **244** may cause a magnet to be mechanically moved within dock **240**. When the mobile device **242** detects the change in the surrounding magnetic field of device **242**, the processor **130** may interpret the change as, for example, a command to raise the volume of the device **242**.

In another implementation dock **240** is an active dock. Active magnetic controllers require power to operate and use electrical current to induce a magnetic field in the area surrounding mobile device **242**. A magnetic field may be induced by transferring current in a particular path, for example, a coil. The intensity of the magnetic field may be controlled by controlling the magnitude of the current in the particular path. For example, the slider **244** and knob **246** may be used to alter the magnitude and path of the current within the dock **240**, which in turn alters the magnitude and direction of the magnetic field surrounding the device **242**. Slider **244** and knob **246** may control a variable resistance in the path of the electrical current used to induce the magnetic field. Similar to the description above with respect to passive docks, when the mobile device detects the change in the surrounding magnetic field of device **242**, the processor **130** may interpret the change as, for example, a command to lower the volume of the device.

FIG. **2**B depicts a magnetic video game controller **210**. The magnetic video game controller **210** may include one or more buttons **214***a*-**214***c* and a joy stick **212**. In some implementations, the joy stick **212** is used to move video game objects across the display of a controlled device, such as a tablet, while the buttons **214***a*-**214***c* are used to initiate specific video game actions. For example, the joy stick **212** may be used to steer a car in a video game, while the button **214** may be used activate the car's breaks. Similar to the discussion above with respect to the dock **240**, the magnetic video game controller **210** may be either passive or active. A passive magnetic video game controller may include a plurality of magnets, each magnet being mechanically movable within the controller. For example, joystick **212** may contain a longitudinal magnet that moves as a user moves the stick **212**, while the buttons **214***a*-**214***c* may each include a magnet that can be moved in response to the user pressing the respective button. The resultant magnetic field from moving joystick **212** and the buttons **214***a*-**214***c* can be detected using magnetometer **130** of mobile device **242**. The processor **130** can interpret the resultant magnetic fields as instructions. For example, the processor **130** can determine that the stick **212** was moved to the left, and in turn, move a car in a video game left.

FIG. **2**C depicts a wearable computer device **230** equipped with a magnetic controller **232**. The device **230** may include a magnetic button **232**, a microphone **224** and electronics **226**, which include a magnetometer. In one implementation, the magnetic button **232** may be used to activate the microphone **224** for the device **230** so that the microphone **224** may be used to receive the voice commands from users. Button **232** may be implemented using a passive or active magnetic device.

FIG. **3** is a flow chart of an example process **300** for controlling a device equipped with a magnetometer, using a magnetic controller. The process **300** starts with obtaining a first magnetic field measurement specifying a strength and a direction of a surrounding magnetic field (**302**). For example, this measurement may be obtained by magnetometer **130** of a mobile device. In one implementation, the strength is specified by a magnitude and the direction is specified in a 3-dimensional space. In some implementations, the magnetic field may be represented by one or more 3-dimensional vectors. This first measurement specifies the net resultant magnetic field in the area surrounding the mobile device, prior to activating the magnetic controller, and is used as a reference magnetic field. For example, the first measurement may specify the net resultant magnetic field of the earth in combination with electric devices in the surrounding area such as power lines or phones.

An alteration of the surrounding magnetic field occurs when the magnetic controller is used. The process **300** obtains a second magnetic field measurement specifying strength and a direction of the surrounding magnetic field (**304**). The second measurement may be obtained by magnetometer **130** of the mobile device. In one implementation the strength is specified by a magnitude and the direction is specified in a 3-dimensional space. In some implementations, the magnetic field may be represented by one or more 3-dimensional vectors. This second measurement specifies the net resultant magnetic field in the area surrounding the mobile device, after the net magnetic field is altered by the magnetic controller.

The process **300** continues by determining whether a difference between the first measurement and the second measurement meets a particular threshold (**306**). The determination may be performed by processor **130** of the mobile device. The determination may be performed by comparing the vectors from the first magnetic field measurement to vectors from the second magnetic field measurement. The threshold may specify a minimum change in magnitude as well as a minimum change in direction. As described above, the direction may be specified in a 3-dimensional space. The particular threshold may be defined based on an expected magnetic interference of the environment the mobile device operates and stored in the input model. The design parameters of the magnetic controller may be used to take into consideration the interference levels expected in the operation environment.

In response to determining that the difference meets the particular threshold the process **300** interprets the difference as input to the mobile device (**308**). Conversely, if the process **300** determines that the difference does not meet the particular threshold, the process **300** may not interpret the difference as input to the mobile device.

In some implementations, the mobile device performs an action in response to the determination that the difference meets the particular threshold. Different actions are described by respective input models for the different magnetic controllers above.

As described above, the difference in a magnetic field may be measured relative to a reference magnetic field. However, in implementations in which an active magnetic device is used, the magnetic field may vary according to a predefined pattern to encode a user input command. For example, a keyboard device may include a controller that drives one or more electro magnets. One example implementation is shown in FIG. **4**, which is a block diagram of an example multi-input device **400** (e.g., a keyboard) with an electronically controlled electromagnetic device **402**. Each keyboard key press or combination of key presses causes a controller **404** to generate a correspondingly unique signal to drive the electromagnetic device **402**, which, in tum, corresponds to a unique variance in the magnetic field surrounding the magnetometer **120** in a device **410**. The variance is indicated by the coupling **420**. The variances may be in the direction of the vector, the magnitude of the vector, or a combination of both. For example, a pressing of the "j" key may cause a first temporary shift (e.g., 50 milliseconds) in the magnetic field at a first magnitude and direction generated by the magnetic device, while the pressing the "k" key may cause a second temporary shift in the magnetic field at a second magnitude and direction. A mapping of the variances to inputs is stored in the input model **138** in the data store **134**, and these magnetic field transient variations are detected by the magnetometer **120** and interpreted as corresponding user input commands by the processor **130**. The transient variations that are detected can also be subject to meeting a minimum magnetic field change in order to be acted upon.

While this specification contains many specific implementation details, these should not be construed as limitations on the scope of any inventions or of what may be claimed, but rather as descriptions of features specific to particular embodiments of particular inventions. Certain features that are described in this specification in the context of separate embodiments can also be implemented in combination in a single embodiment. Conversely, various features that are described in the context of a single embodiment can also be implemented in multiple embodiments separately or in any suitable subcombination. Moreover, although features may be described above as acting in certain combinations and even initially claimed as such, one or more features from a claimed combination can in some cases be excised from the combination, and the claimed combination may be directed to a subcombination or variation of a subcombination.

Similarly, while operations are depicted in the drawings in a particular order, this should not be understood as requiring that such operations be performed in the particular order shown or in sequential order, or that all illustrated operations be performed to achieve desirable results. Moreover, the separation of various system components in the embodiments described above should not be understood as requiring such separation in all embodiments, and it should be understood that the described components and systems can generally be integrated together in a single product.

Thus, particular embodiments of the subject matter have been described. Other embodiments are within the scope of the following claims. In some cases, the actions recited in the claims can be performed in a different order and still achieve desirable results. In addition, the processes depicted in the accompanying figures do not necessarily require the particular order shown, or sequential order, to achieve desirable results.

What is claimed is:

1. A system for magnetically controlling a device, the system comprising:

a magnetic controller external to the device, the magnetic controller including:

a magnetic device for altering a surrounding magnetic field of the device;

one or more input actuators, each input actuator operatively coupled to the magnetic device and that when actuated cause the magnetic device to alter the surrounding magnetic field according to a predefined change associated with the input actuator; and

a model executable by the device and that models as device inputs a plurality of differences in the surrounding magnetic field of the device caused by the actuation of the one or more input actuators based at least in part on each difference of the plurality of differences in the surrounding magnetic field satisfying a magnetic field threshold change, the model filtering, based on the magnetic field threshold change, a change in an orientation of the device in an ambient magnetic field from the modeled device inputs.

2. The system of claim **1**, wherein the magnetic device comprises an electrical device that is operable to induce a magnetic field that alters the surrounding magnetic field based on the predefined changes associated with the input actuators.

3. The system of claim **2**, wherein the electrical device comprises an electromagnet.

4. The system of claim **2**, wherein the magnetic controller is a powered device dock.

5. The system of claim **2**, wherein the magnetic controller is an unpowered device dock for receiving the device and comprising one or more internal passive magnets that are mechanically movable within the dock to alter the surrounding magnetic field of the device when the device is received by the unpowered device dock.

6. The system of claim **2**, wherein an input actuator comprises a button operatively connected to a passive magnet and that when activated displaces the passive magnet to alter the surrounding magnetic field.

7. The system of claim **2**, wherein an input actuator comprises a joystick operatively connected to a passive magnet and that when activated displaces the passive magnet to alter the surrounding magnetic field.

8. The system of claim **1**, wherein the magnetic device comprises a passive magnet that is operable to induce a magnetic field that alters the surrounding magnetic field based on the predefined changes associated with the input actuators.

9. A method for magnetically controlling a device, the method comprising:

altering, by a magnetic device of a magnetic controller external to the device, a surrounding magnetic field of the device;

actuating one or more input actuators operatively coupled to the magnetic device, to cause the magnetic device to alter the surrounding magnetic field according to a predefined change associated with the one or more input actuators; and

executing, by the device, a model that models as device inputs a plurality of differences in the surrounding magnetic field of the device caused by the actuation of the one or more input actuators based at least in part on each difference of the plurality of differences in the surrounding magnetic field satisfying a magnetic field threshold change, the model filtering, based on the magnetic field threshold change, a change in an orientation of the device in an ambient magnetic field from the modeled device inputs.

10. The method of claim **9**, wherein the magnetic controller is a powered device dock.

11. The method of claim **9**, wherein the magnetic controller is an unpowered device dock for receiving the device and comprising one or more internal passive magnets that are mechanically movable within the dock to alter the surrounding magnetic field of the device when the device is received by the unpowered device dock.

12. The method of claim **11**, further comprising inducing, at the one or more passive magnets of the magnetic device, a magnetic field that alters the surrounding magnetic field based on the predefined changes associated with the input actuators.

13. The method of claim **11**, further comprising displacing the passive magnet by activating the one or more input actuators to alter the surrounding magnetic field, wherein the input actuator comprises a button operatively connected to the passive magnet.

14. The method of claim **11**, further comprising displacing the passive magnet by activating the one or more input actuators to alter the surrounding magnetic field, wherein the input actuator comprises a joystick operatively connected to the passive magnet.

15. A method, comprising:

inducing, at a magnetic controller, a magnetic field in an area surrounding a device by transferring current in a path;

controlling, at the magnetic controller, an intensity of the magnetic field by controlling a magnitude of the current in the path; and

executing, by the device, a model that models as device inputs a plurality of differences in the surrounding magnetic field of the device caused by the controlling of the intensity of the magnetic field, wherein the model models the device inputs based at least in part on each difference of the plurality of differences in the surrounding magnetic field satisfying a magnetic field threshold change, the model filtering, based on the magnetic field threshold change, a change in an orientation of the device in an ambient magnetic field from the modeled device inputs.

16. The method of claim **15**, further comprising altering, at a slider of the magnetic controller, the magnitude or the path of the current.

17. The method of claim **15**, further comprising altering, at a knob of the magnetic controller, the magnitude or the path of the current.

18. The method of claim **15**, further comprising controlling a variable resistance in the path of the current.

19. The method of claim **15**, further comprising interpreting, at a processor of the device, a change in the surrounding magnetic field of the device as a command.

20. The method of claim **15**, wherein inducing the magnetic field comprises transferring current in a coil.

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