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(54) **Title:** HUMAN MOTION DETECTION

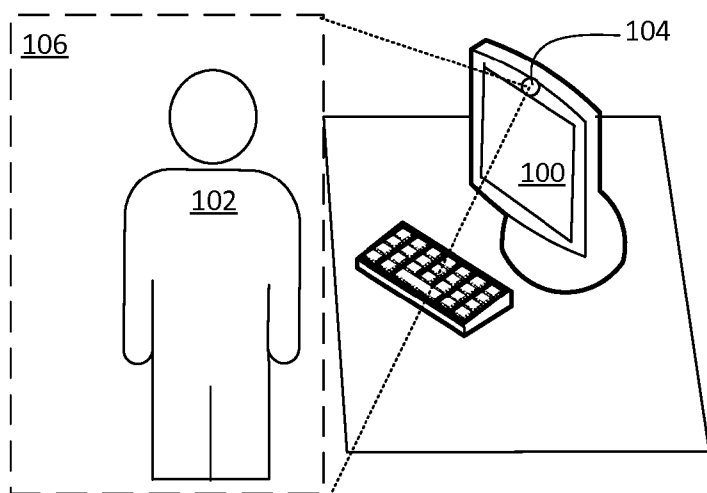


FIG. 1

(57) **Abstract:** A system configured to collect sensor data and compare the sensor data to a first template profile comprising data indicative of an approach of a user or compare the sensor data to a second template profile comprising data indicative of a departure of a user, or a combination thereof to determine whether the sensor data indicates the approach of a user or a departure of a user.

HUMAN MOTION DETECTION

TECHNICAL FIELD

Examples described herein generally relate to methods, systems, and devices to detect user
5 motion.

BACKGROUND

Determining human presence or absence in front of a computing device may require
expensive hardware and tax processing resources.
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BRIEF DESCRIPTION OF THE DRAWINGS

The various advantages of the embodiments will become apparent to one skilled in the art
by reading the following specification and appended claims, and by referencing the following
drawings, in which:

15 **FIG. 1** is a diagram illustrating an example of a device configured to detect a user motion;
FIG. 2 is a block diagram illustrating an example of a device configured to detect user
motion;

FIG. 3 is a diagram illustrating an example of a system for analyzing user motions to
identify an intent to engage a device;

20 **FIG. 4** is a diagram illustrating an example of a system for analyzing user motions to
identify an intent to disengage a device;

FIG. 5 is a diagram illustrating an example of a data structure for selecting one or more
template profiles to compare with sensor data;

25 **FIG. 6** illustrates an example of a process to detect a presence or absence of a user in an
area to trigger analysis of user motions by a device;

FIG. 7 is a flow diagram illustrating an example process for determining a presence or
absence of a user in an area;

FIG. 8 illustrates an example of a process to analyze user motions to determine if a user is
likely to engage or disengage from device; and

30 **FIG. 9** is a block diagram of an exemplary information handling system capable of
implementing a system for analyzing user motions.

DETAILED DESCRIPTION

FIG. 1 is a diagram illustrating an example of a device **100** configured to detect a user
motion. User motions may be analyzed to determine whether or not a user **102** is likely to start

using or stop using device **100**. In an example, if user **102** approaches, departs from or otherwise moves into a position to engage or disengage device **100**, user **102** may execute one or more motions that are characteristic of an intent to engage and/or disengage device **100**. Sensor **104** may be coupled to device **100** and may be configured to detect such motions within an area **106** and collect sensor data associated with the detected motions. Area **106** may be a predefined area proximate device **100** and/or may be an area within range of sensor **104**, or the like or a combination thereof. Area **106** may comprise a field of view of sensor **104**. Sensor **104** may send sensor data to memory to be stored and/or send the sensor data to a processor for processing to determine whether or not a user **102** is likely to start using or stop using device **100** based on the sensor data. Sensor **104** may be configured to transmit sensor data via a wireless communication system and/or via wireline communications. Such a wireless communication system may include, a Radio Frequency Identification (RFID) system, a Wi-Fi™ system, a Bluetooth™ system, a Zigbee™ system, WiMax™ system, or the like or a combination thereof.

In an example, device **100** may be coupled to one sensor **104** or more than one sensor **104**. Sensor **104** may be physically in contact with device **100** or may be remote and not physically in contact with device **100**. Where there are two or more sensors **104** one or more sensors **104** may be in physical contact with device **100**. Sensor **104** may comprise any of a variety of sensors, such as: an infra-red (IR) image sensor, a thermal image sensor, an optical sensor, an electro-optical sensor, an ultrasonic sensor, a light sensor, a biometric sensor, a pressure sensor, a microwave sensor, an image sensor, a motion sensor or a video sensor, or the like or a combination thereof. Device **100** may comprise any of a variety of devices, such as: a desktop computer, a laptop computer, a mobile communications device, a mobile computing device, a tablet, a notebook, a detachable slate device, an Ultrabook™ system, a wearable communications device, or a wearable computer, or a combination thereof.

FIG. 2 is a block diagram illustrating an example of a device **100** configured to detect user motion. Sensor **104** may detect and capture sensor data **210** associated with area **106**. Sensor **104** may send sensor data **210** to processor **202** and/or may send sensor data **210** to be stored in memory **204**. Sensor data **210** may be post-processed, filtered, and/or normalized. In an example, sensor **104** may record sensor data **210** at predetermined intervals by sampling, when triggered by an event and/or on a periodic or continuous basis. An event that may trigger recording of sensor data **210** may comprise detection of user **102** entering and/or leaving area **106**.

In an example, processor **202** may receive sensor data **210** from sensor **104**. Processor **202** may analyze sensor data **210** to determine whether user **102** is likely to engage device **100** or likely to disengage from or discontinue use of device **100**. In an example, processor **202** may process sensor data **210** on a periodic and/or continuous basis such as at predetermined time

intervals, during sampling, when triggered by an event and/or on a continuous basis. The likelihood that a user intends to engage or disengage device **100** may be inferred by processor **202** from a user's motions in the vicinity of device **100**. For example, processor **202** may be configured to identify based on sensor data **210** whether user **102** is approaching device **100** in area **106** and/or identify based on sensor data **210** if user **102** is departing from area **106** proximate device **100**. Processor **202** may determine that a user is likely to engage device **100** if processor **202** determines that user **102** is approaching device **100**. Likewise, processor **202** may determine that a user is likely to disengage from device **100** if processor **202** determines that user **102** is departing from area **106**.

In an example, processor **202** may detect an intent of user **102** to engage or disengage device **100** based on identifying a change in a sample of sensor data **210** from a previously collected sample of sensor data **210**, identifying a change from a norm in sensor data **210** and/or a comparison of sensor data **210** to a template profile. Such a change in sensor data **210** may be caused by user **102** entering or leaving area **106** and/or other user motions indicative of an intent to engage or disengage device **100**.

In an example, sensor **104** may read a moving window of sensor data **210**. A moving window herein may refer to a set of sensor **104** readings having a particular sample size and/or taken in a particular time interval. The moving window may comprise, for example, sensor data **210** comprising the previous n seconds of data recorded, the previous n data points and/or the like or combination thereof. Any of a variety of moving window parameters may be set. A moving window of sample data changes as sample data points are read and new data points are added to a frame of the moving window and older points sample data points are discarded.

In an example, motions user **102** may make indicative of their intent to engage and/or disengage device **100** may vary widely and may depend upon the context within which device **100** is to be used. Processor **202** may be configured to analyze sensor data **210** based on a context of device **100**. Such context may include the type of device **100** to be engaged and/or disengaged, whether the device is being used indoors or outdoors, whether device **100** is being used at home or in the office, whether device **100** is disposed on a traditional desk or a standing desk and the like, or combinations thereof.

In an example, in a context where device **100** comprises a desktop computer disposed on a traditional desk, motions user **102** may execute indicative of an intent to engage or disengage device **100** may include: walking up to device **100**, walking away from device **100**, sitting down in front of device **100**, rising from a sitting position in front of device **100** and/or the like or combinations thereof. In another example, device **100** may be a mobile computing device. In such a context, motions user **102** may execute indicative of their intent to engage and/or

disengage device **100** may comprise: picking device **100** up, moving device **100** into position in front of user **102**, setting device **100** on the lap of user **102**, lifting device **100** off of the lap of user **102**, setting device **100** down on a surface, or the like or a combination thereof.

In an example, processor **202** may trigger one or more actions based on a determination of whether or not user **102** is likely to engage device **100** or likely to disengage from or discontinue use of device **100**. Examples of such actions include and are not limited to: an authentication process, a password process, a wake-up process, a facial recognition process, a shutdown process, an energy saving mode, a secure mode, an upload of data, a download of data, an alarm or the like, and/or a combination thereof.

FIG. 3 is a diagram illustrating an example of a system **300** for analyzing user **102** motions to identify an intent to engage a device **100**. In an example, user **102** may approach device **100** moving in the direction of arrow **310**. Processor **202** may detect user **102** in area **106** based on sensor data **210** corresponding to motions user **102** may make while approaching device **100**. In an example, processor **202** may compare sensor data **210** to one or more template profiles which may be stored in memory **204**. Sensor data **210** may comprise a waveform. Processor **202** may access the one or more template profiles from memory **204**. Such template profiles may comprise first waveform **304** and/or second waveform **306**. First waveform **304** may represent data characteristic of a user approaching or “walking up” to device **100**. Second waveform **306** may represent data characteristic of a user departing from or “walking away” from device **100**. First waveform **304** and second waveform **306** are shown for purposes of example in **FIG. 3** and **FIG. 4**. First waveform **304** and second waveform **306** may have different shapes and content than that shown and may comprise analog or digital waveforms and the scope of the claimed subject matter is not limited in this respect.

In an example, processor **202** may be configured to determine and/or quantify a strength of a match between sensor data **210** and either or both of first waveform **304** and/or second waveform **306** to determine whether user **102** is approaching device **100** and/or departing from device **100**. Processor **202** may be configured to quantify a match strength between sensor data **210** and first waveform **304** and/or second waveform **306**. In an example, processor **202** may be configured to calculate one or more normalized cross-correlation coefficients between sensor data **210** and first waveform **304** and/or between sensor data **210** and second waveform **306** to quantify the match strength between sensor data **210** and first waveform **304** and/or second waveform **306**. Processor **202** may be configured to compare the match strength to a threshold match strength, for example, by comparing the one or more normalized cross-correlation coefficients to a threshold coefficient. Memory **204** may store one or more threshold coefficient.

In an example, processor **202** may determine that the normalized cross-correlation coefficient quantifying the match between sensor data **210** and first waveform **304** meets or exceeds a corresponding threshold coefficient. Processor **202** may determine that user **102** is approaching device **100** and may infer that user **102** intends to use device **100** based on such determination. Processor **202** may trigger an action to be executed by device **100** based on determining that user **102** is approaching device **100**. An action to be triggered may facilitate use of device **100** by user **102**. Such an action may hasten and/or simplify a powering-on process, a booting-up process, an authorization process or the like or a combination thereof. Examples of an action processor **202** may trigger and/or execute responsive to a determination that the normalized cross-correlation coefficient quantifying the match between sensor data **210** and first waveform **304** meets or exceeds a corresponding threshold coefficient may include: switching device **100** to an “ON” state, initiating an authentication process, requesting a password, initiating a facial recognition process, or the like or a combination thereof.

FIG. 4 is a diagram illustrating an example of a system **400** for analyzing user **102** motions in device **100** to identify an intent to disengage a device **100**. In an example, user **102** may move away from device **100** in the direction of arrow **410**. Sensor **104** may detect user in area **106** and may capture sensor data **210** corresponding to motions user **102** may make while departing from device **100**. In an example, processor **202** may compare sensor data **210** to the one or more template profiles. Sensor data **210** may comprise a waveform.

In an example, processor **202** may be configured to determine and/or quantify a strength of a match between sensor data **210** and either or both of first waveform **304** and/or second waveform **306** to determine whether user **102** is approaching device **100** and/or departing from device **100**. Processor **202** may be configured to find one or more normalized cross-correlation coefficients by comparing sensor data **210** and first waveform **304** and/or comparing sensor data **210** and second waveform **306**. Processor **202** may be configured to compare the one or more normalized cross-correlation coefficient quantifying the strength of a match between sensor data **210** and first waveform **304** and/or sensor data **210** and second waveform **306** with a threshold value such as a threshold coefficient.

In an example, processor **202** may determine that the normalized cross-correlation coefficient quantifying the match between sensor data **210** and second waveform **306** meets or exceeds a corresponding threshold coefficient. Based on such determination, processor **202** may determine that user **102** is departing from device **100** and may infer that user **102** intends to stop using device **100**. Processor **202** may trigger an action to be executed by device **100** based on determining that user **102** is departing from device **100**. An action to be triggered may hasten and/or simplify a powering-down process, a security process, a management process or the like

or a combination thereof. Examples of an action processor **202** may trigger and/or execute responsive to a determination that the normalized cross-correlation coefficient quantifying the match between sensor data **210** and second waveform **306** meets or exceeds a corresponding threshold coefficient may include: toggling device **100** to an “OFF” state, initiating an energy saving mode, beginning a data upload, initiating a security procedure, terminating recording of sensor data, or the like or a combination thereof.

In an example, one or more template profiles such as first waveform **304** and/or second waveform **306** may be selected from memory **204** by processor **202**. The one or more template profiles may be obtained from experimental data classifying meaningful motions from sensor **104** readings over one or more samples. The one or more template profiles may each be associated with a particular user action such as “walking up” and/or “walking away.”

In an example, the experimental data may be gathered in and thus associated with a particular context. Such contexts may include: indoors, outdoors, a traditional desktop computer, a standing desktop computer, a mobile device, or the like or a combination thereof. In an example, in a particular context, sensor data **210** may be collected over several samples of a user executing one or more particular motions prior to engaging and/or disengaging a device such as “walking up” to or “walking away” from the device. The device used during experimentation may be representative of a class of devices to which the template profiles may be made applicable such as a desktop computer, laptop computer, mobile phone, tablet, or the like or a combination thereof. The experimental sensor data may be post processed: filtered and/or normalized. A waveform or other graph may be generated to obtain a template profile associated with the particular motions being observed, the device and/or the context.

In an example, a template profile such as first waveform **304** and/or second waveform **306** may be generated by processor **202** during a calibration process. Processor **202** may generate first waveform **304** and/or second waveform **306** by modifying previously stored waveforms based on calibration data. The calibration data may comprise sensor readings captured by sensor **104** taken during a calibration process wherein a user may demonstrate particular motions associated with an intent to engage and/or disengage from device **100**. Such calibration may enable increased accuracy in recognizing user motions indicative of an intent to engage and/or disengage device **100**.

FIG. 5 is a diagram illustrating an example of a data structure **500** for selecting one or more template profiles to compare with sensor data **210**. The one or more template profiles may be selected based on a context of device **100**. In an example, the one or more template profiles may be mapped to and/or otherwise associated with one or more contexts in data structure **500**. For example, first waveform **304** may be mapped to an indoor environment **502**, a stationary

device **504**, a traditional desktop device **506** and an approach **508** of user **102**. Similarly, second waveform **306** may be mapped to an indoor environment **502**, a stationary device **504**, a traditional desktop device **506** and a departure **510** of user **102**. Thus, processor **202** may select one or more template profiles to compare with sensor data **210** based on the context of device

5 100.

In an example, data structure **500** may include several other possible template profile selections, such as, for example, waveforms A-F. Waveforms A-B may be mapped to respective ones of various contexts including: indoor environment **502**, stationary device **504**, standing desktop device **524**, an approach **526** or departure **528** of a user **102**, or the like or a combination

10 thereof. Waveforms C-F may be mapped to respective ones of various contexts including indoor environment **502**, mobile device **530**, laptop computer **532**, mobile phone **534**, positioning on user lap **536**, off user lap **538**, holding up **540** and/or turning away **542**, or the like or combinations thereof.

In an example, data structure **500** may be stored in a database **550** in memory **204** of device **100**. Processor **202** may be configured to access database **550** and select a template profile, such as, for example first waveform **304** and/or second waveform **306** or a combination thereof based on at least one context associated with device **100**.

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FIG. 6 illustrates an example of a process **600** to detect a presence or absence of a user **102** in area **106** to trigger analysis of user **102** motions by device **100**. Process **600** begins at operation **602** where sensor **104** may periodically and/or continuously capture sensor data **210**.

20 Moving to operation **604**, processor **202** may receive sensor data **210** from sensor **104** and/or memory **204**. At operation **606**, processor **202** may identify a trigger event. A trigger event may indicate a user **102** intent to engage and/or disengage device **100** such as when user **102** is enters or leaves area **106**. In an example, to identify the trigger event, processor **202** may identify a

25 change in a particular metric in sensor data **210**, for example, by comparing a current sensor data point with a previous sensor data point. Example metrics may include and are not limited to: temperature, decibel level, activity, motion, pressure, a biological parameter, light, or the like or a combination thereof. Processor **202** may determine that an identified change is significant based on a threshold analysis. If the change is significant based on a threshold analysis,

30 processor **202** may further analyze the sensor data **210**. Processor **202** may monitor a norm, such as an average and standard deviation of the particular metric in a moving frame of samples of sensor data **210**. Processor **202** may compare the current sensor data point to the average and standard deviation of a previous sample set of the sensor data **210** to determine whether the current sensor data point is within a threshold number of standard deviations from the average. If

35 the current sensor data point is outside of the threshold number of standard deviations from the

average, processor **202** may determine that a trigger event has occurred indicating a user **102** intent to engage and/or disengage device **100**. If processor **202** identifies a trigger event, process **600** may move to operation **608**. At operation **608**, processor **202** may analyze user **102** motion responsive to the trigger event. Such analysis of user **102** motion may comprise comparing the
5 sensor data **210** to one or more template profiles representing data associated with a particular user motion. In an example, processor **202** may quantify a quality of a match between sensor data **210** and the one or more template profiles. Processor **202** may analyze the match quality to determine which if any template profile satisfies a threshold standard for match quality. In an example where there is one template profile, processor **202** may determine the template profile is
10 a successful match if the match quality exceeds the threshold match quality. Where there are more than one template profiles, processor **202** may determine that the template profile having the highest match quality that exceeds the threshold standard for match quality is the successful match. At operation **610**, processor **202** may determine whether user **102** is likely to engage and/or disengage device **100** based on identifying a successful match to a template profile during
15 the analysis of user motion. In an example, the one or more template profiles are each associated with a particular user motion indicative of an intent to engage or disengage device **100**.

In an example of process **600**, sensor **104** may be an infrared sensor used to take temperature readings in area **106**. At operation **602**, a stream of samples of sensor data **210** may be read and captured by sensor **104**. At operation **604**, processor **202** may receive and process the stream of
20 samples of sensor data **210**. At operation **606**, processor **202** may identify a trigger event by comparing consecutive temperature readings such as a current temperature reading and a prior temperature reading. A temperature differential between the consecutive temperature readings may be determined to be significant by, for example, comparing the detected temperature differential to a temperature differential threshold. If the temperature differential exceeds the
25 temperature differential threshold the detected temperature differential may be considered significant and processor **202** may proceed to execute subsequent processing of the sensor data **210**. Such subsequent processing may comprise determining an average temperature and a standard deviation of a set of samples of sensor data **210** taken prior to the current temperature reading. Processor **202** may compare the current temperature reading to the calculated average
30 and standard deviation of the set of samples to determine whether the current temperature is within a threshold standard deviation. If the current temperature exceeds a threshold standard deviation of the set of samples then processor **202** may proceed to operation **608** to analyze user motions by comparing sensor data **210** to one or more waveforms representing template profile data associated with a user walking up to or walking away from device **100**. If a sufficiently high quality match is

found based on a threshold match quality analysis between the sensor data **210** and the one or more waveforms, processor **202** may move to operation 610. At operation 610, processor **202** may determine whether user **102** is likely to engage and/or disengage device **100** based on the user motion analysis. Processor **202** may execute an action to facilitate use and/or shut-down of device **100** based on the determination.

FIG. 7 is a flow diagram illustrating an example process **700** for determining a presence or absence of a user **102** in an area **106**. At operation **702** processor **202** receives an infrared (IR) data stream from sensor **104** where sensor **104** is an IR sensor. At operation **703**, processor **202** may continuously calculate the standard deviation on a moving frame of samples from the IR data stream. Process **700** may proceed from operation **702** to operation **704** where processor **202** may compare a current sample reading to an immediate past sample reading in the IR data stream to identify a temperature differential. At operation **706**, processor **202** may check for a significant temperature differential by determining whether the temperature differential is greater than a threshold differential. A significant temperature differential may be an indicator that a person is entering or leaving area **106**. Using a threshold check on a temperature differential may indicate possible human movement on the moving window of sensor data samples as a trigger for human presence detection. If the temperature differential is greater than the threshold differential then process **700** may proceed to operation **708**. Otherwise, if the temperature differential is not greater than the threshold differential then process **700** may proceed to operation **702**. At operation **708**, processor **202** may compare the current sample reading with a calculated average and standard deviation of a set of samples in the moving frame of samples from the IR data stream preceding the current sample reading. In an example, the average and standard deviation may have been previously calculated for the set of samples as processor **202** may be configured to continuously calculate an average and standard deviation on the moving frame of samples from the IR data stream. Processor **202** may determine whether the current sample reading is within a threshold standard deviation of the average. If the current sample reading is outside the threshold standard deviation of the average then process **700** may continue to operation **710**. At operation **710**, processor **202** may normalize a cross-correlation between a moving frame of samples from the data stream and a “walk up” and/or “walk away” signal. A “walk up” and/or “walk away” signal may be obtained for a human user **102** by experiment. This may consist of collected data from the infrared sensor **104** that is post-processed: filtered, and/or normalized. A similarity between the sensor feed and the standardized “walk away” and “walk up” signals may be quantified by looking at the normalized cross correlation coefficient between the moving frame of samples from the IR data stream and the standardized signals. At

operation 712, processor 202 may use threshold cutoffs on normalized cross-correlation coefficients in conjunction with standard deviation thresholds to determine presence and/or absence of user 102 in area 106. Processor 202 may use threshold cutoffs on normalized cross-correlation coefficients found by experimental procedures, in conjunction with standard
5 deviation thresholds that are found by experiment, to determine the presence or absence of a human user 102. Process 700 may proceed to operation 702.

FIG. 8 illustrates an example of a process 800 to analyze user 102 motions to determine if user 102 is likely to engage or disengage from device 100. Process 800 begins at operation 802 where processor 202 may receive sensor data to be analyzed. Sensor 104 may periodically and/or
10 continuously capture sensor data 210 and send sensor data 210 to processor 202. The sensor data 210 may be based on a moving frame of sensor 104 readings. At operation 804, processor 202 may compare the sensor data 210 with a first waveform 304 and/or a second waveform 306 to determine whether user 102 is likely to engage or disengage from device 100. First waveform 304 and/or a second waveform 306 may be selected from a database and/or generated by
15 processor 202 responsive to sensor data 210. Selection of the first waveform 304 and/or second waveform 306 may be based on context. In an example, the first waveform 304 may comprise a shape having characteristic features associated with motions a user 102 may make with an intent to engage device 100. The second waveform 306 may comprise a shape having characteristic features associated with motions a user 102 may make with an intent to disengage from device
20 100. At operation 808, processor 202 may generate one or more normalized cross-correlation coefficients based on the comparison of sensor data 210 with the first waveform 304 and/or the second waveform 306. For example, processor 202 may generate a first normalized cross-correlation coefficient based on a comparison of sensor data 210 and the first waveform 304. Processor 202 may generate a second normalized cross-correlation coefficient based on a
25 comparison of sensor data 210 and the second waveform 306. At operation 810, processor 202 may compare the one or more normalized cross-correlation coefficients to a threshold coefficient value. For example, processor 202 may compare the first normalized cross-correlation coefficient with the threshold coefficient value and/or may compare the second normalized cross-correlation coefficient with the threshold coefficient value.

30 At operation 812, processor 202 may determine whether user 102 is likely to engage and/or disengage with device 100 based on the comparison of the one or more normalized cross-correlation coefficients to a threshold coefficient value. For example, if first normalized cross-correlation coefficient meets or exceeds a threshold coefficient value then processor 202 may determine that user 102 is present in area 106 and intends to engage device 100. If second

normalized cross-correlation coefficient meets or exceeds a threshold coefficient value then processor **202** may determine that user **102** is absent from or leaving area **106** and intends to disengage device **100**. At operation **814**, processor **202** may trigger an action based on the determining whether user **102** is likely to engage or disengage device **100**.

5 Disclosed herein are examples of one or more methods for receiving sensor data representative of temperature information captured in a field of view of an infrared (IR) sensor, detecting if a temperature differential in the received sensor data exceeds a threshold value, quantifying a similarity between the sensor data received during the detected temperature differential and one or more stored profiles and determining a presence or an absence of a user in
10 the field of view of the IR sensor based on the similarity between the data received during the detected temperature differential and at least one of the stored profiles. In an example, the quantifying may comprise normalizing a cross-correlation between the sensor data received during the detected temperature differential and the one or more stored profiles. In an example, one or more stored profiles may comprise a profile for a user entering the field of view of the IR
15 sensor and/or a profile for a user exiting the field of view of the IR sensor. The one or more methods may further comprise updating at least one of the stored profiles with the data received during the detected temperature differential if said determining determines the presence or absence of the user. The one or more methods may further comprise continuously calculating a standard deviation on frames of samples in the sensor data and using a standard deviation
20 threshold in said determining to determine a presence or absence of the user. The one or more methods may further comprise authorizing the user to access an electronic device if the sensor data received during the detected temperature differential matches one of the one or more stored profiles.

 Disclosed herein are examples of one or more devices to detect a user approach or
25 departure or a combination thereof, comprising a sensor to collect sensor data and a processor to compare the sensor data to a first template profile comprising data indicative of an approach of a user or compare the sensor data to a second template profile comprising data indicative of a departure of a user, or a combination thereof to determine whether the sensor data indicates the approach of a user or a departure of a user. In an example, the processor may be further
30 configured to trigger a first action if the sensor data indicates the approach of the user and trigger a second action if the sensor data indicates the departure of the user, or a combination thereof, quantify a similarity between the sensor data and the first template profile to generate a first normalized cross correlation coefficient between the sensor data and the first template profile and quantify a similarity between the sensor data and the second template profile to generate a

second normalized cross correlation coefficient between the sensor data and the second template profile. In an example, the processor may be configured to compare a threshold coefficient value with the first cross correlation coefficient or the second cross correlation coefficient, or a combination thereof to identify the approach or departure of the user. In an example, the first
5 template profile may be a first waveform and the second template profile is a second waveform. In an example, the processor may be configured to select the first waveform or the second waveform or a combination thereof based on a context of the device. In an example, the context of the device corresponds to whether the device is indoors, outdoors, a desktop device, a mobile device, a laptop device, or a slate device or a combination thereof. In an example, the first
10 template profile or the second template profile or a combination thereof is based on experimental data correlated to context. In an example, the processor may derive the first template profile or the second template profile or a combination thereof from supplemental sensor data collected during a calibration process. In an example, the first template profile or the second template profile or a combination thereof may be based on data that is filtered or normalized or a
15 combination thereof. In an example, the processor may determine a differential between a first sample value and a second sample value of the sensor data measuring a particular metric, compare the differential to a threshold differential value, responsive to the differential exceeding the threshold differential value, trigger determination of an average value and a standard deviation of the average value of the particular metric for a set of samples of the sensor data,
20 compare the first sample value with the average and determine whether the first sample value is within a threshold standard deviation of the average value and responsive to the first sample value exceeding the threshold standard deviation, trigger the processor to compare the sensor data to the first template profile or the second template profile, or a combination thereof. In an example, the sensor comprises an infra-red (IR) image sensor, a thermal image sensor, an optical
25 sensor, an electro-optical sensor, an ultrasonic sensor, a light sensor, a biometric sensor, a pressure sensor, a microwave sensor, an image sensor, a motion sensor or a video sensor, or a combination thereof. In an example, the device may comprise a desktop computer, a laptop computer, a mobile communications device, a mobile computing device, a tablet, a notebook, a detachable slate device, an Ultrabook™ system, a wearable communications device, or a
30 wearable computer, or a combination thereof.

Disclosed herein are examples of one or more methods to detect a user motion proximate a device, comprising receiving, by a processor, sensor data corresponding to an area proximate the device, determining, by the processor, whether a differential value of a first point and a second point in the sensor data exceeds a threshold differential, wherein if the differential value exceeds

the threshold differential then determining, by the processor, whether the first point is outside of a norm for the sensor data, wherein if the first point is determined to be outside of the norm then triggering, by the processor, execution of a user motion analysis and determining, by the processor, a user intent to engage or disengage the device based on the user motion analysis. In an example, the user motion analysis comprises comparing, by the processor, the sensor data to one or more template profiles associated with a particular user motion to identify a user motion indicative of a user intent to engage or disengage the device. The one or more template profiles may comprise a first waveform and a second waveform. In an example, the method may further comprise quantifying, by the processor, a match strength between the sensor data and the one or more template profiles, comparing, by the processor, the match strength to a threshold match strength, identifying, by the processor, a successful match to a template profile based on the comparing, determining, by the processor, a particular user motion represented by the sensor data based on the identifying the successful match and inferring, by the processor, the user intent to engage or disengage the device based on the particular user motion represented by the sensor data. In an example, the method may further comprise triggering, by the processor, a first action based on inferring a user intent to engage the device, wherein the first action is an authentication process, password process, a wake-up process or a facial recognition process, or a combination thereof or triggering, by the processor, a second action based on inferring a user intent to disengage the device, wherein the second action is a shutdown process, an energy saving mode, a secure mode, an upload of data, or an alarm or a combination thereof. In an example, the method may further comprise selecting, by the processor, the one or more template profiles based on a context of the device wherein the context of the device corresponds to whether the device is indoors, outdoors, a desktop device, a mobile device, a laptop device, or a slate device or a combination thereof. The one or more template profiles may be based on experimental data correlated to a context. In an example, the method may further comprise deriving, by the processor, the one or more template profiles during a calibration process wherein the sensor data is filtered or normalized or a combination thereof and wherein the sensor data comprises infra-red (IR) image sensor data, thermal image sensor data, optical sensor data, electro-optical sensor data, ultrasonic sensor data, light sensor data, biometric sensor data, pressure sensor data, microwave sensor data, image sensor data, motion sensor data, or video sensor data, or a combination thereof. The device may comprise a desktop computer, a mobile communications device, a mobile computing device, a tablet, a notebook, a detachable slate device, an Ultrabook™ system, a wearable communications device, or a wearable computer, or a combination thereof.

Referring now to **FIG. 9**, a block diagram of an information handling system capable of implementing a system for analyzing user motions in accordance with one or more embodiments will be discussed. User motion analyzing system **900** of **FIG. 9** may tangibly embody any one or more of the elements described herein, above, including for example system **300** described above and depicted in **FIG. 3** or system **400** described above and depicted in **FIG. 4** with greater or fewer components depending on the hardware specifications of the particular device. Although user motion analyzing system **900** represents one example of several types of computing platforms, user motion analyzing system **900** may include more or fewer elements and/or different arrangements of elements than shown in **FIG. 9**, and the scope of the claimed subject matter is not limited in these respects.

In one or more embodiments, user motion analyzing system **900** may include an application processor **910** and a baseband processor **912**. Application processor **910** may be utilized as a general-purpose processor to run applications and the various subsystems for user motion analyzing system **900**. Application processor **910** may include a single core or alternatively may include multiple processing cores wherein one or more of the cores may comprise a digital signal processor or digital signal processing (DSP) core. Furthermore, application processor **910** may include a graphics processor or coprocessor disposed on the same chip, or alternatively a graphics processor coupled to application processor **910** may comprise a separate, discrete graphics chip. Application processor **910** may include on board memory such as cache memory, and further may be coupled to external memory devices such as synchronous dynamic random access memory (SDRAM) **914** for storing and/or executing applications during operation, and NAND flash **916** for storing applications and/or data even when user motion analyzing system **900** is powered off. In one or more embodiments, instructions to operate or configure the user motion analyzing system **900** and/or any of its components or subsystems to operate in a manner as described herein may be stored on an article of manufacture comprising a non-transitory storage medium. In one or more embodiments, the storage medium may comprise any of the memory devices shown in and described herein, although the scope of the claimed subject matter is not limited in this respect. Baseband processor **912** may control the broadband radio functions for user motion analyzing system **900**. Baseband processor **912** may store code for controlling such broadband radio functions in a NOR flash **918**. Baseband processor **912** controls a wireless wide area network (WWAN) transceiver **920** which is used for modulating and/or demodulating broadband network signals, for example for communicating via a 3GPP LTE or LTE-Advanced network or the like.

In general, WWAN transceiver **920** may operate according to any one or more of the following radio communication technologies and/or standards including but not limited to: a Global System for Mobile Communications (GSM) radio communication technology, a General Packet Radio Service (GPRS) radio communication technology, an Enhanced Data Rates for GSM Evolution (EDGE) radio communication technology, and/or a Third Generation Partnership Project (3GPP) radio communication technology, for example Universal Mobile Telecommunications System (UMTS), Freedom of Multimedia Access (FOMA), 3GPP Long Term Evolution (LTE), 3GPP Long Term Evolution Advanced (LTE Advanced), Code division multiple access 2000 (CDMA2000), Cellular Digital Packet Data (CDPD), Mobitex, Third Generation (3G), Circuit Switched Data (CSD), High-Speed Circuit-Switched Data (HSCSD), Universal Mobile Telecommunications System (Third Generation) (UMTS (3G)), Wideband Code Division Multiple Access (Universal Mobile Telecommunications System) (W-CDMA (UMTS)), High Speed Packet Access (HSPA), High-Speed Downlink Packet Access (HSDPA), High-Speed Uplink Packet Access (HSUPA), High Speed Packet Access Plus (HSPA+), Universal Mobile Telecommunications System-Time-Division Duplex (UMTS-TDD), Time Division-Code Division Multiple Access (TD-CDMA), Time Division-Synchronous Code Division Multiple Access (TD-CDMA), 3rd Generation Partnership Project Release 8 (Pre-4th Generation) (3GPP Rel. 8 (Pre-4G)), UMTS Terrestrial Radio Access (UTRA), Evolved UMTS Terrestrial Radio Access (E-UTRA), Long Term Evolution Advanced (4th Generation) (LTE Advanced (4G)), cdmaOne (2G), Code division multiple access 2000 (Third generation) (CDMA2000 (3G)), Evolution-Data Optimized or Evolution-Data Only (EV-DO), Advanced Mobile Phone System (1st Generation) (AMPS (1G)), Total Access Communication System/Extended Total Access Communication System (TACS/ETACS), Digital AMPS (2nd Generation) (D-AMPS (2G)), Push-to-talk (PTT), Mobile Telephone System (MTS), Improved Mobile Telephone System (IMTS), Advanced Mobile Telephone System (AMTS), OLT (Norwegian for Offentlig Landmobil Telefoni, Public Land Mobile Telephony), MTD (Swedish abbreviation for Mobiltelefonisystem D, or Mobile telephony system D), Public Automated Land Mobile (Autotel/PALM), ARP (Finnish for Autoradiopuhelin, “car radio phone”), NMT (Nordic Mobile Telephony), High capacity version of NTT (Nippon Telegraph and Telephone) (Hicap), Cellular Digital Packet Data (CDPD), Mobitex, DataTAC, Integrated Digital Enhanced Network (iDEN), Personal Digital Cellular (PDC), Circuit Switched Data (CSD), Personal Handy-phone System (PHS), Wideband Integrated Digital Enhanced Network (WiDEN), iBurst, Unlicensed Mobile Access (UMA), also referred to as also referred to as 3GPP Generic Access Network, or GAN standard), Zigbee, Bluetooth®, and/or general telemetry transceivers, and in general any type of RF circuit or RFI sensitive circuit. It should be noted that such standards may evolve

over time, and/or new standards may be promulgated, and the scope of the claimed subject matter is not limited in this respect.

The WWAN transceiver **920** couples to one or more power amps **942** respectively coupled to one or more antennas **924** for sending and receiving radio-frequency signals via the WWAN
5 broadband network. The baseband processor **912** also may control a wireless local area network (WLAN) transceiver **926** coupled to one or more suitable antennas **928** and which may be capable of communicating via a Wi-Fi, Bluetooth®, and/or an amplitude modulation (AM) or frequency modulation (FM) radio standard including an IEEE 702.11 a/b/g/n standard or the like. It should be noted that these are merely example implementations for application processor **910**
10 and baseband processor **912**, and the scope of the claimed subject matter is not limited in these respects. For example, any one or more of SDRAM **919**, NAND flash **916** and/or NOR flash **918** may comprise other types of memory technology such as magnetic memory, chalcogenide memory, phase change memory, or ovonic memory, and the scope of the claimed subject matter is not limited in this respect.

15 In one or more embodiments, application processor **910** may drive a display **930** for displaying various information or data, and may further receive touch input from a user via a touch screen **932** for example via a finger or a stylus. Application processor **910** may receive sensor data **210** or other input via a IR Sensor **970**. An ambient light sensor **934** may be utilized to detect an amount of ambient light in which information handling system **900** is operating, for
20 example to control a brightness or contrast value for display **930** as a function of the intensity of ambient light detected by ambient light sensor **934**. One or more cameras **936** may be utilized to capture images that are processed by application processor **910** and/or at least temporarily stored in NAND flash **916**. Furthermore, application processor may couple to a gyroscope **938**, accelerometer **940**, magnetometer **942**, audio coder/decoder (CODEC) **944**, and/or global
25 positioning system (GPS) controller **946** coupled to an appropriate GPS antenna **948**, for detection of various environmental properties including location, movement, and/or orientation of user motion analyzing system **900**. Alternatively, controller **946** may comprise a Global Navigation Satellite System (GNSS) controller. Audio CODEC **944** may be coupled to one or more audio ports **950** to provide microphone input and speaker outputs either via internal devices
30 and/or via external devices coupled to information handling system via the audio ports **950**, for example via a headphone and microphone jack. In addition, application processor **910** may couple to one or more input/output (I/O) transceivers **952** to couple to one or more I/O ports **954** such as a universal serial bus (USB) port, a high-definition multimedia interface (HDMI) port, a serial port, and so on. Furthermore, one or more of the I/O transceivers **952** may couple to one

or more memory slots **956** for optional removable memory such as secure digital (SD) card or a subscriber identity module (SIM) card, although the scope of the claimed subject matter is not limited in these respects.

In an example, processor **202** and/or memory **204** may be integrated together with the
5 processing device, for example RAM or FLASH memory disposed within an integrated circuit microprocessor or the like. In other examples, the memory may comprise an independent device, such as an external disk drive, a storage array, a portable FLASH key fob, or the like. The memory and processor **202** and/or memory **204** may be operatively coupled together, or in communication with each other, for example by an I/O port, a network connection, or the like,
10 and the processing device may read a file stored on the memory. Associated memory may be "read only" by design (ROM) by virtue of permission settings, or not. Other examples of memory may include, but may not be limited to, WORM, EPROM, EEPROM, FLASH, or the like, which may be implemented in solid state semiconductor devices. Other memories may comprise moving parts, such as a conventional rotating disk drive. All such memories may be
15 "machine-readable" and may be readable by a processing device.

Operating instructions or commands may be implemented or embodied in tangible forms of stored computer software (also known as "computer program" or "code"). Programs, or code, may be stored in a digital memory and may be read by the processing device. "Computer-readable storage medium" (or alternatively, "machine-readable storage medium") may include all
20 of the foregoing types of memory, as well as new technologies of the future, as long as the memory may be capable of storing digital information in the nature of a computer program or other data, at least temporarily, and as long as the stored information may be "read" by an appropriate processing device. The term "computer-readable" may not be limited to the historical usage of "computer" to imply a complete mainframe, mini-computer, desktop or even laptop
25 computer. Rather, "computer-readable" may comprise storage medium that may be readable by a processor, a processing device, or any computing system. Such media may be any available media that may be locally and/or remotely accessible by a computer or a processor, and may include volatile and non-volatile media, and removable and non-removable media, or the like, or any combination thereof.

30 A program stored in a computer-readable storage medium may comprise a computer program product. For example, a storage medium may be used as a convenient means to store or transport a computer program. For the sake of convenience, the operations may be described as various interconnected or coupled functional blocks or diagrams. However, there may be cases

where these functional blocks or diagrams may be equivalently aggregated into a single logic device, program or operation with unclear boundaries.

Having described and illustrated the principles of examples, it should be apparent that the examples may be modified in arrangement and detail without departing from such principles. We
5 claim all modifications and variations coming within the spirit and scope of the following claims.

CLAIMS

What is claimed is:

1. A method, comprising:

receiving sensor data representative of temperature information captured in a field of
5 view of an infrared (IR) sensor;

detecting if a temperature differential in the received sensor data exceeds a threshold
value;

quantifying a similarity between the sensor data received during the detected temperature
differential and one or more stored profiles; and

10 determining a presence or an absence of a user in the field of view of the IR sensor based
on the similarity between the data received during the detected temperature differential and at
least one of the stored profiles.

2. A method as claimed in claim 1, wherein the one or more stored profiles comprises a profile
for a user entering the field of view of the IR sensor.

15 3. A method as claimed in claim 1, wherein the one or more stored profiles comprises a profile
for a user exiting the field of view of the IR sensor.

4. A method as claimed in claim 1, further comprising updating at least one of the stored profiles
with the data received during the detected temperature differential if said determining determines
the presence or absence of the user.

20 5. A method as claimed in claim 1, further comprising continuously calculating a standard
deviation on frames of samples in the sensor data and using a standard deviation threshold in
said determining to determine a presence or absence of the user.

6. A method as claimed in claim 1, wherein said quantifying comprises normalizing a cross-
correlation between the sensor data received during the detected temperature differential and the
25 one or more stored profiles.

7. A method as claimed in claim 1, further comprising authorizing the user to access an
electronic device if the sensor data received during the detected temperature differential matches
one of the one or more stored profiles.

8. A device to detect a user approach or departure or a combination thereof, comprising:

a sensor to collect sensor data; and

a processor to compare the sensor data to a first template profile comprising data indicative of an approach of a user or compare the sensor data to a second template profile comprising data indicative of a departure of a user, or a combination thereof to determine
5 whether the sensor data indicates the approach of a user or a departure of a user.

9. The device of claim 8, wherein the processor is further to:

trigger a first action if the sensor data indicates the approach of the user; and

trigger a second action if the sensor data indicates the departure of the user, or a combination thereof.

10 10. The device of claim 8, wherein the processor is to:

quantify a similarity between the sensor data and the first template profile to generate a first normalized cross correlation coefficient between the sensor data and the first template profile; and

quantify a similarity between the sensor data and the second template profile to generate
15 a second normalized cross correlation coefficient between the sensor data and the second template profile.

11. The device of claim 10, wherein the processor is to compare a threshold coefficient value with the first cross correlation coefficient or the second cross correlation coefficient, or a combination thereof to identify the approach or departure of the user.

20 12. The device of claim 8, wherein the first template profile is a first waveform and the second template profile is a second waveform.

13. The device of claim 12, wherein the processor is further to select the first waveform or the second waveform or a combination thereof based on a context of the device.

14. The device of claim 13, wherein the context of the device corresponds to whether the
25 device is indoors, outdoors, a desktop device, a mobile device, a laptop device, or a slate device or a combination thereof.

15. The device of claim 8, wherein the processor is to:

determine a differential between a first sample value and a second sample value of the sensor data measuring a particular metric;

compare the differential to a threshold differential value;

responsive to the differential exceeding the threshold differential value, trigger

5 determination of an average value and a standard deviation of the average value of the particular metric for a set of samples of the sensor data;

compare the first sample value with the average and determine whether the first sample value is within a threshold standard deviation of the average value; and

10 responsive to the first sample value exceeding the threshold standard deviation, trigger the processor to compare the sensor data to the first template profile or the second template profile, or a combination thereof.

16. The device of claim 8, wherein the sensor comprises an infra-red (IR) image sensor, a thermal image sensor, an optical sensor, an electro-optical sensor, an ultrasonic sensor, a light sensor, a biometric sensor, a pressure sensor, a microwave sensor, an image sensor, a motion
15 sensor or a video sensor, or a combination thereof.

17. The device of claim 8, wherein the device comprises a desktop computer, a laptop computer, a mobile communications device, a mobile computing device, a tablet, a notebook, a detachable slate device, an Ultrabook™ system, a wearable communications device, or a wearable computer, or a combination thereof.

20 18. A method to detect a user motion proximate a device, comprising:

receiving, by a processor, sensor data corresponding to an area proximate the device;

determining, by the processor, whether a differential value of a first point and a second point in the sensor data exceeds a threshold differential;

25 if the differential value exceeds the threshold differential then determining, by the processor, whether the first point is outside of a norm for the sensor data;

if the first point is determined to be outside of the norm then triggering, by the processor, execution of a user motion analysis; and

determining, by the processor, a user intent to engage or disengage the device based on the user motion analysis.

19. The method of claim 18, wherein the user motion analysis comprises comparing, by the processor, the sensor data to one or more template profiles associated with a particular user motion to identify a user motion indicative of a user intent to engage or disengage the device.

5 20. The method of claim 19, further comprising:

quantifying, by the processor, a match strength between the sensor data and the one or more template profiles; and

comparing, by the processor, the match strength to a threshold match strength;

10 identifying, by the processor, a successful match to a template profile based on the comparing;

determining, by the processor, a particular user motion represented by the sensor data based on the identifying the successful match; and

inferring, by the processor, the user intent to engage or disengage the device based on the particular user motion represented by the sensor data.

15 21. The method of claim 18, further comprising:

triggering, by the processor, a first action based on inferring a user intent to engage the device, wherein the first action is an authentication process, password process, a wake-up process or a facial recognition process, or a combination thereof; or

20 triggering, by the processor, a second action based on inferring a user intent to disengage the device, wherein the second action is a shutdown process, an energy saving mode, a secure mode, an upload of data, or an alarm or a combination thereof.

22. The method of claim 20, wherein the device comprises a desktop computer, a mobile communications device, a mobile computing device, a tablet, a notebook, a detachable slate device, an Ultrabook™ system, a wearable communications device, or a wearable computer, or a
25 combination thereof.

23. An apparatus comprising means to perform a method as claimed in any of claims 1-7 and 18-22.

24. Machine-readable storage including machine-readable instructions, when executed, to implement a method or realize an apparatus as claimed in any preceding claim.

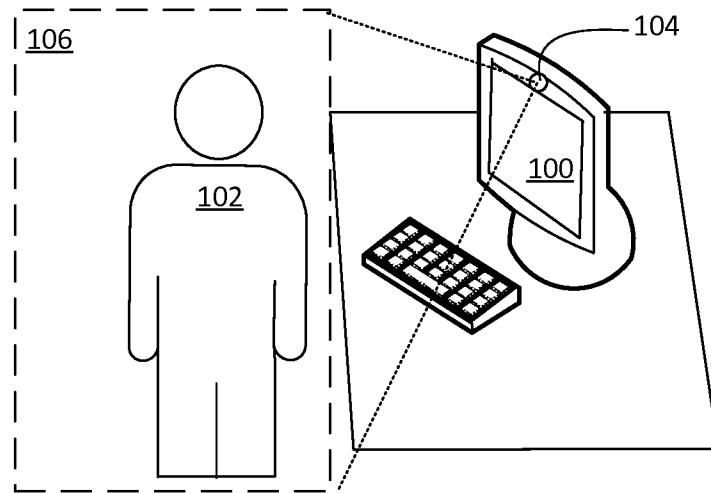


FIG. 1

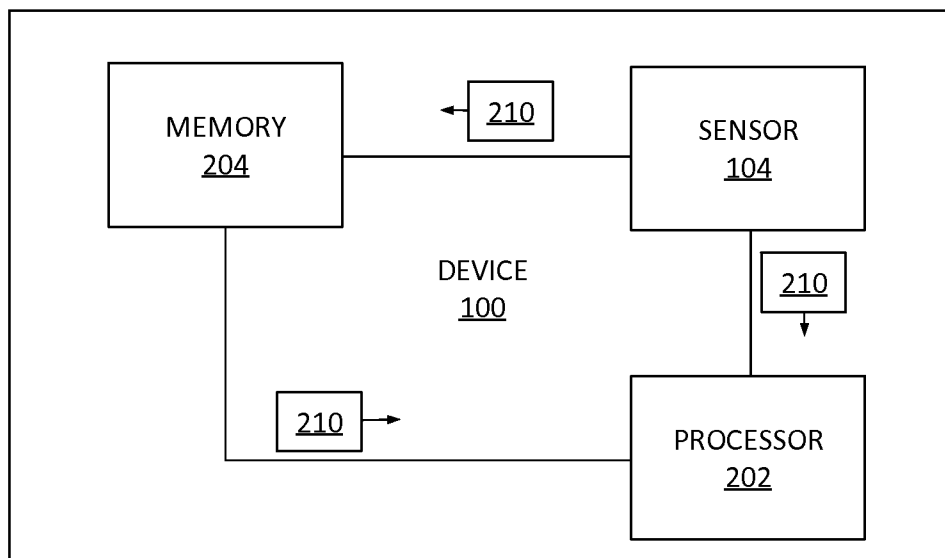


FIG. 2

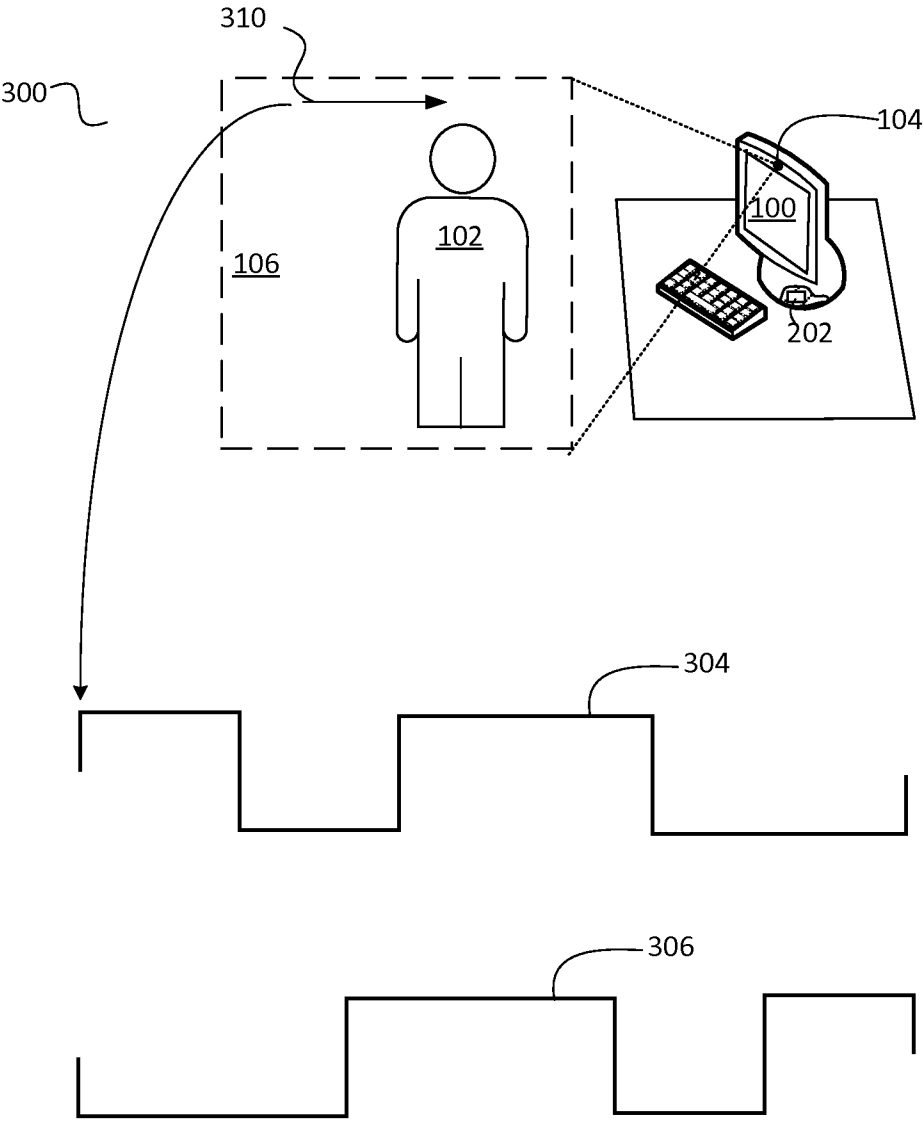


FIG. 3

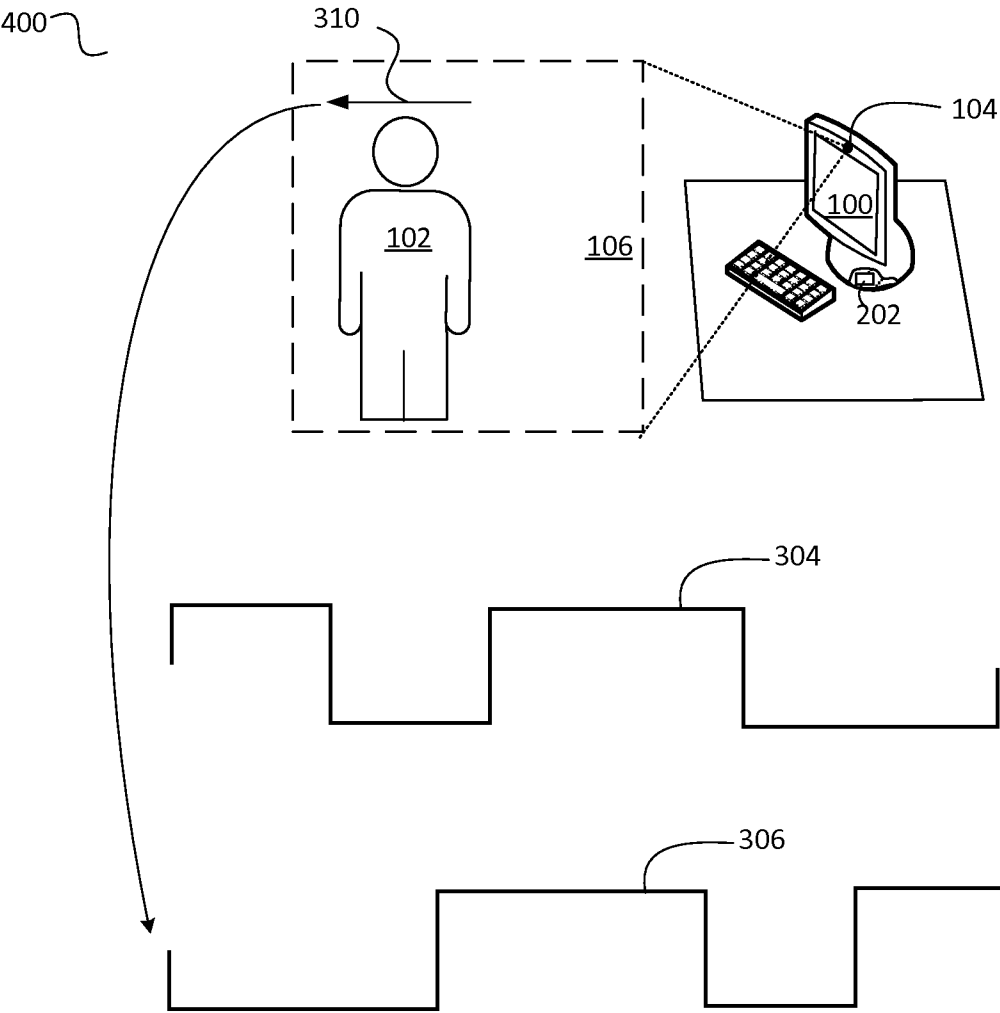


FIG. 4

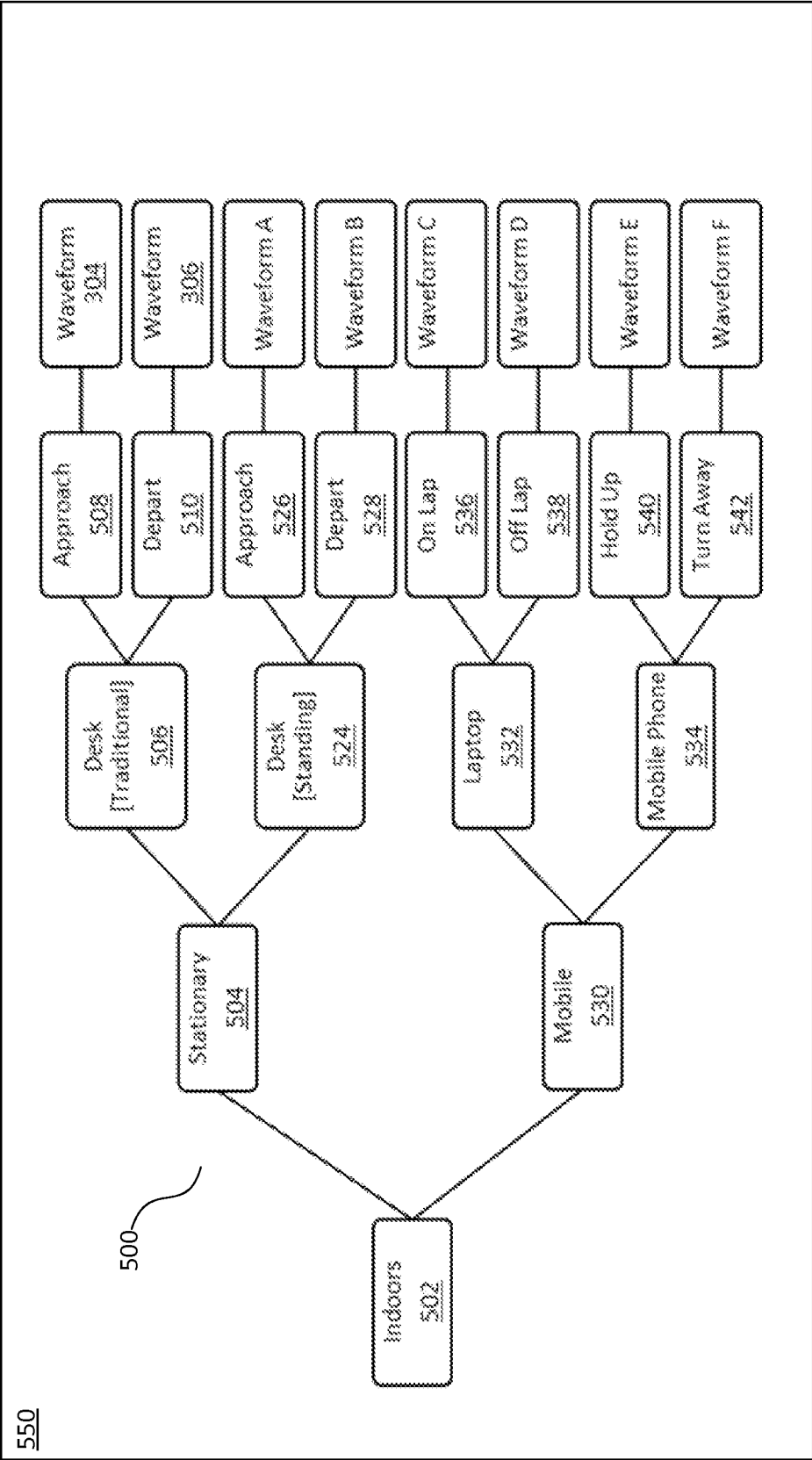


FIG. 5

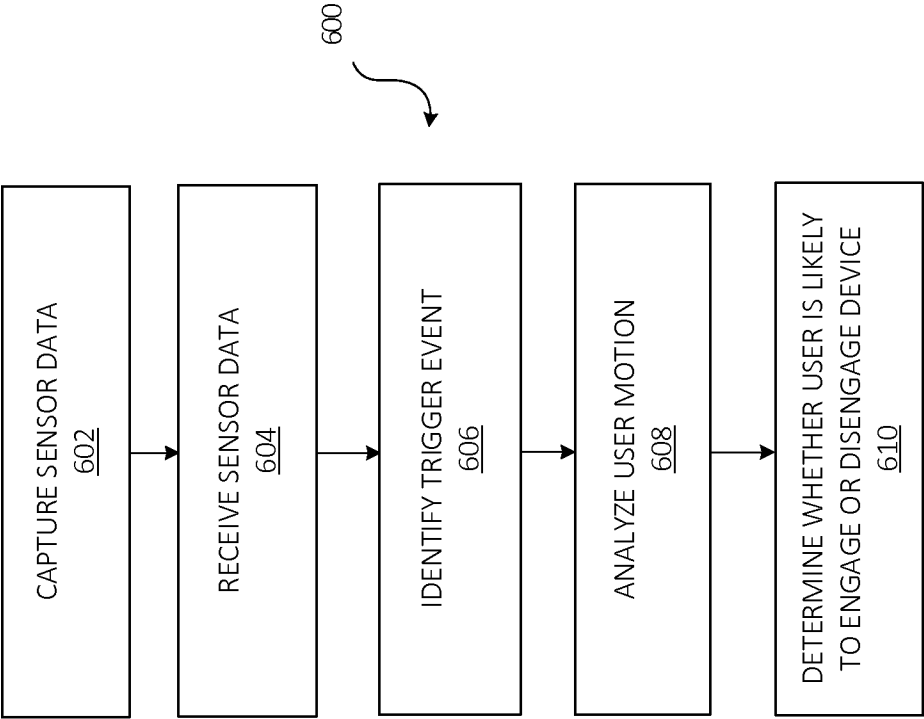


FIG. 6

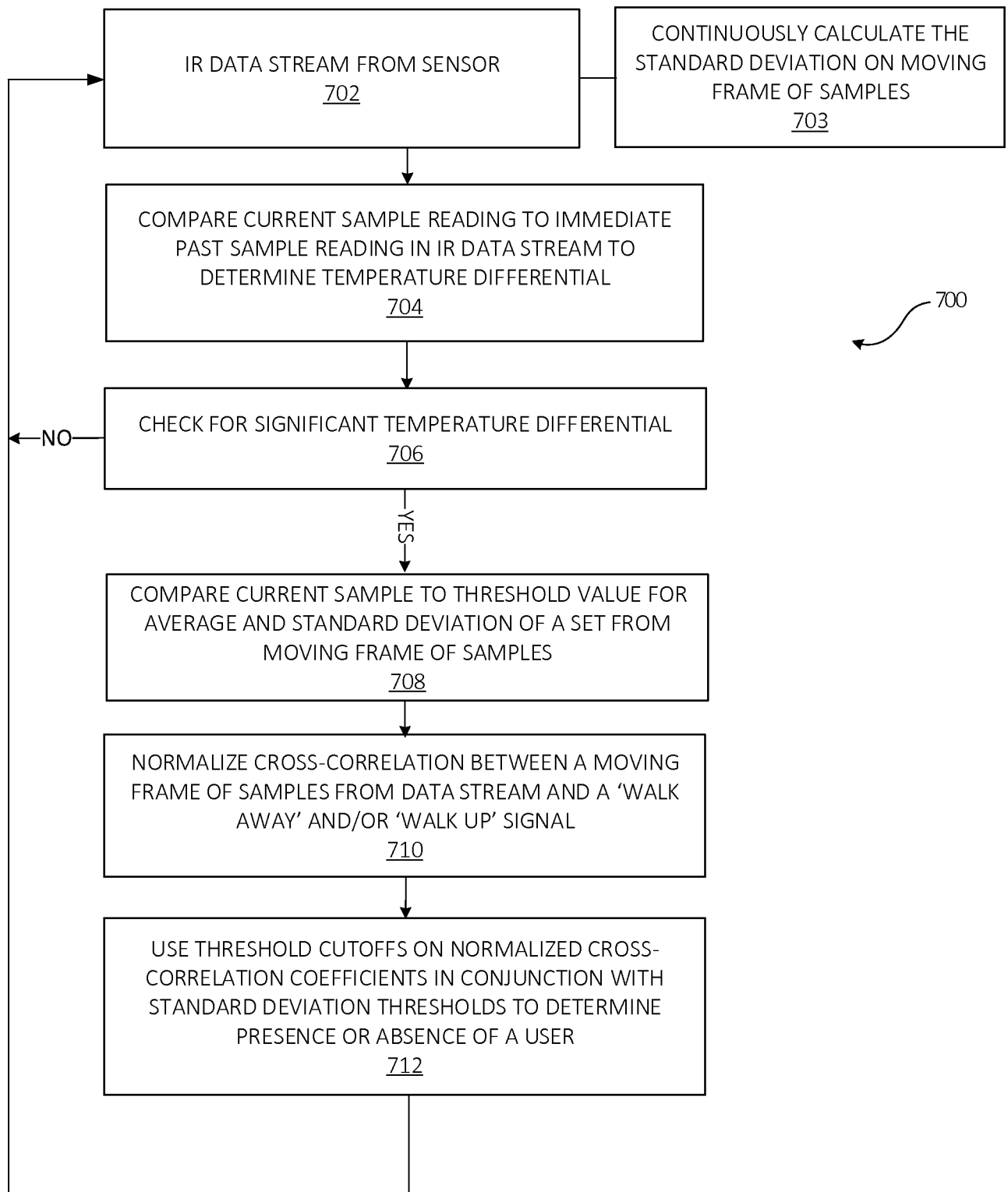


FIG. 7

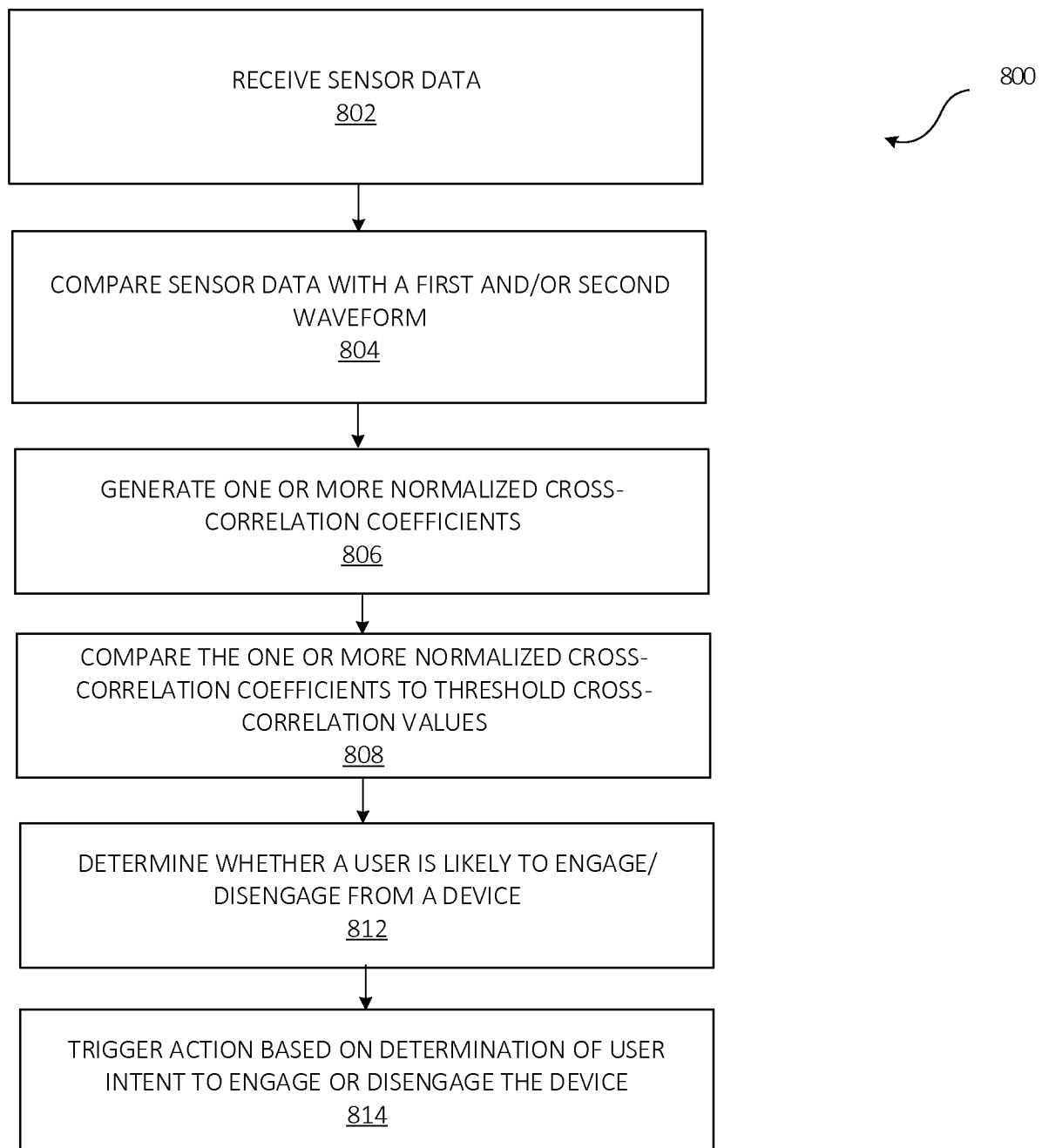


FIG. 8

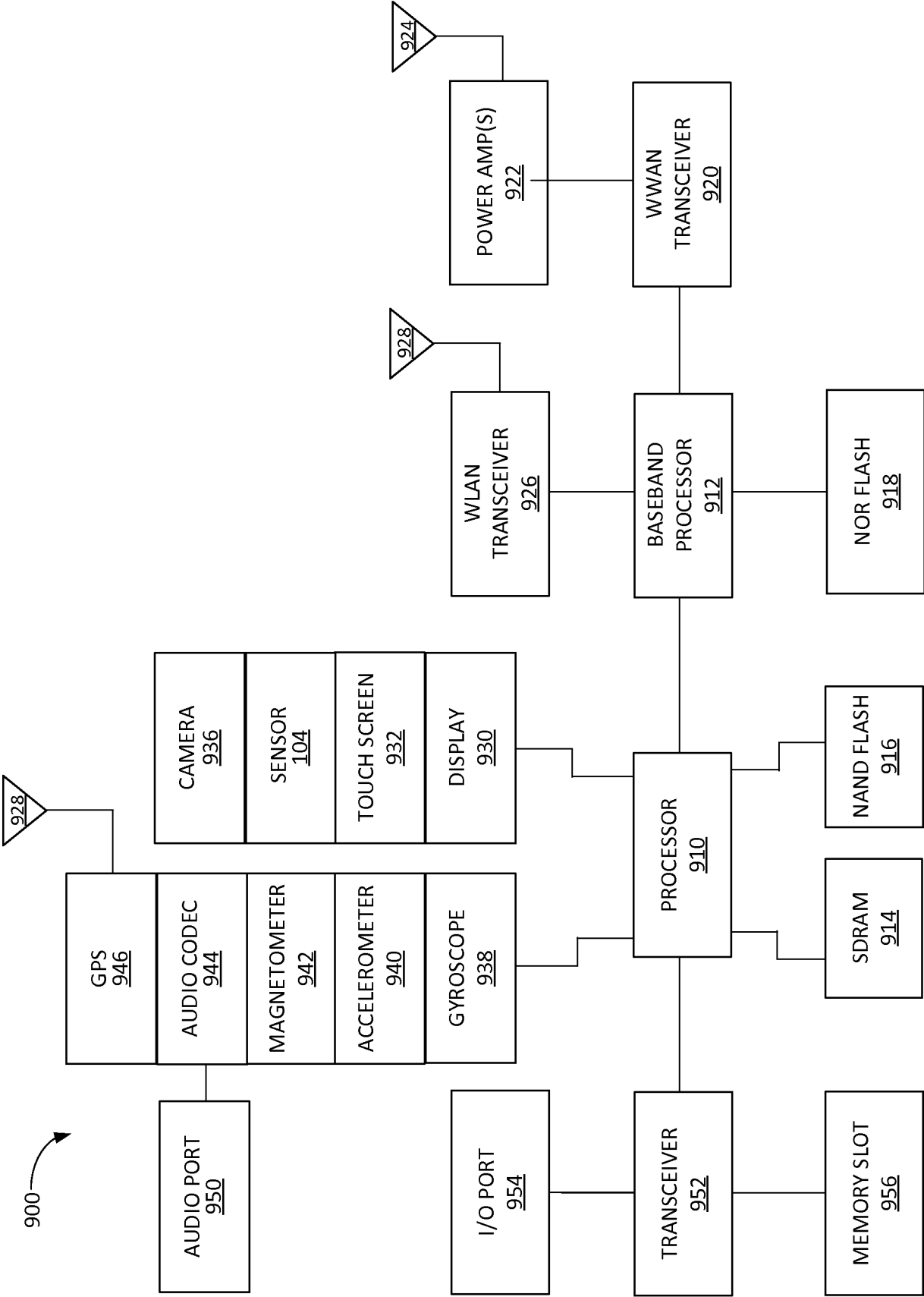


FIG. 9

A. CLASSIFICATION OF SUBJECT MATTER**G06F 3/01(2006.01)i**

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHEDMinimum documentation searched (classification system followed by classification symbols)
G06F 3/01; G06F 15/00; G06F 17/00; H01L 31/0328; G01C 22/00; G06F 1/32; G09G 5/00Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Korean utility models and applications for utility models
Japanese utility models and applications for utility modelsElectronic data base consulted during the international search (name of data base and, where practicable, search terms used)
eKOMPASS(KIPO internal) & Keywords: sensor, data, temperature, infrared, detect, differential, threshold, value, similarity, template**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2002-0080132 A1 (XIA DAI et al.) 27 June 2002 See paragraphs [0016], [0020], [0023], [0025]; claims 1, 13; and figure 2A.	1, 18, 21, 23-24
Y		2-17, 19-20, 22
Y	US 2011-0054833 A1 (ANDREA MUCIGNAT) 03 March 2011 See paragraphs [0004]-[0006], [0021], [0064], [0066]; and figures 1, 8.	2-4, 6-17, 19-20, 22
Y	US 2008-0161946 A1 (KAZUTO KUBOTA et al.) 03 July 2008 See paragraph [0009]; and figure 1.	5, 15
A	WO 2012-155105 A1 (APPLE INC.) 15 November 2012 See paragraphs [0029]-[0030]; and figures 1-3.	1-24
A	US 2003-0151062 A1 (JAE-SOO CHO) 14 August 2003 See paragraphs [0026]-[0031], [0037]; and figures 3, 5A.	1-24



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

17 February 2016 (17.02.2016)

Date of mailing of the international search report

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Name and mailing address of the ISA/KR

International Application Division

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/US2015/059228

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2002-0080132 A1	27/06/2002	US 6650322 B2	18/11/2003
US 2011-0054833 A1	03/03/2011	AU 2010-290006 A1	15/03/2012
		AU 2010-290006 B2	28/11/2013
		CN 102713792 A	03/10/2012
		EP 2473896 A2	11/07/2012
		JP 2013-504119 A	04/02/2013
		KR 10-2012-0052411 A	23/05/2012
		KR 10-2012-0057640 A	05/06/2012
		WO 2011-028325 A2	10/03/2011
		WO 2011-028325 A3	26/05/2011
US 2008-0161946 A1	03/07/2008	CN 101211496 A	02/07/2008
		JP 04417951 B2	17/02/2010
		JP 2008-167296 A	17/07/2008
		US 7653456 B2	26/01/2010
WO 2012-155105 A1	15/11/2012	CN 103534664 A	22/01/2014
		EP 2712431 A1	02/04/2014
		JP 2014-519091 A	07/08/2014
		KR 10-2014-0002034 A	07/01/2014
		US 2012-0287031 A1	15/11/2012
		US 2012-0287035 A1	15/11/2012
US 2003-0151062 A1	14/08/2003	CN 1189031 C	09/02/2005
		CN 1437412 A	20/08/2003
		EP 1333682 A1	06/08/2003
		JP 2003-288599 A	10/10/2003
		KR 10-0465244 B1	13/01/2005
		KR 10-2003-0066234 A	09/08/2003
		US 7280596 B2	09/10/2007