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**(54) WEARABLE ELECTRONIC DEVICE AND METHOD FOR SECURING SAME**

ELEKTRONISCHES WEARABLE DEVICE UND VERFAHREN ZU DESSEN SCHUTZ  
DISPOSITIF ÉLECTRONIQUE PORTABLE SUR SOI ET PROCÉDÉ POUR LE SÉCURISER

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## Description

### TECHNICAL FIELD

**[0001]** The present disclosure is related generally to wearable electronic devices and, more particularly, to a method and apparatus for securing a wearable electronic device.

### BACKGROUND

**[0002]** Wearable electronic devices, such as smart watches, are becoming more popular. Such devices are able to synchronize with non-wearable devices, such as smart phones. For example, when a user receives a text message on a smart phone, the smart phone can push the message out to the wearable device. The wearable device may then display the message on a user interface (e.g., on a watch face).

**[0003]** One issue with wearable electronic devices is security. For example, when a person takes off his or her smart watch and leaves it on a table in a restaurant, a passerby may be able to see the user's email.

### DRAWINGS

**[0004]** While the appended claims set forth the features of the present techniques with particularity, these techniques, together with their objects and advantages, may be best understood from the following detailed description taken in conjunction with the accompanying drawings of which:

FIG. 1A is an exterior view of a wearable electronic device according to an embodiment;

FIG. 1B is an exterior view of a wearable electronic device while it is being worn by a user, who is holding a companion electronic device;

FIG. 2 is a block diagram depicting components of a wearable electronic device according to an embodiment;

FIG. 3 is a block diagram depicting components of a companion electronic device according to an embodiment; and

FIGS. 4, 5 and 6 show flowcharts that illustrate the operation of different embodiments.

### DESCRIPTION

**[0005]** This disclosure is generally directed to a method for securing a wearable electronic device ("wearable device"). According to various embodiments, the wearable device (e.g., a smart watch) determines whether a user's pulse is present. If the user's pulse is determined not to

be present, the wearable device secures itself. For example, the wearable device may lock its user interface and prompt the user for the entry of a password or personal identification number. The wearable device may also signal another electronic device (e.g., a paired communication device, such as a smart phone) to indicate that the wearable device is no longer being worn by a user. The other electronic device (referred to herein as a "companion device") may then react by, for example, ceasing to push user messages (e.g., text messages or emails) wirelessly to the wearable device. The companion device may also react to the signal from the wearable device by prompting for entry of a password or personal identification number.

**[0006]** The disclosure is also directed to a wearable device that is configured to secure itself based on signals received from a pulse sensor. In an embodiment, the pulse sensor includes a light source (e.g., a light-emitting diode) and a photo sensor. The light source, under the control of a processor, shines light having a particular wavelength (e.g., green or infrared). The photo sensor generates signals based on light that it senses. For example, when the light from the light source reflects off a person's skin, then the photo sensor will generate signals based on the reflected light that the photo sensor detects. In one embodiment, the pulse sensor captures a photoplethysmogram ("PPG"), in which the reflected light from a person's skin creates a particular signature that the processor interprets to determine the presence of a pulse. In this manner, the wearable device can accurately determine whether it is being worn by a user. For example, when the wearable device is a smart watch, then the presence of a human pulse from the user's wrist will manifest in the reflected light signature and lead the processor to conclude that the watch is, in fact, being worn. This allows for greater certainty than, for example, using proximity detection alone, which may be triggered by mere proximity of an object, such as the surface of a table.

**[0007]** In an embodiment, the wearable device also has a proximity sensor, which may use the same components as the pulse sensor (e.g., the same light source and the same photo sensor). In some implementations, the power consumption required by the light source to perform PPG is greater than the power consumption the light source requires when performing proximity sensing. To address this issue, the wearable device may carry out a first pulse detection to verify that the wearable device is being worn (e.g., using the required power from the light source), and then carry out periodic proximity detections (e.g., by flashing the light source at a lower power periodically and sensing the reflection) to determine whether the user's skin is still present (i.e., proximal to the wearable device). If the wearable device does not detect the user's skin to be present, then the wearable device carries out a second pulse detection. The wearable device may then secure itself (or not) based on this second pulse detection.

**[0008]** In still another embodiment, the wearable de-

vice triggers its pulse check off of motion (e.g., as detected by a motion sensor). If, for example, the wearable device detects motion, then it checks for a pulse. If the wearable device detects a pulse, then it initiates an authentication procedure in which it prompts the user for a password or personal identification number (either directly through the user interface of the wearable device or via the companion device). If, however, the wearable device has previously gone through this procedure (e.g., the wearable device is already being worn, but the user just moves in a way that causes the wearable device to move), then the wearable device checks for a pulse. If the wearable device does not detect a pulse, the wearable device secures itself. If the wearable device does detect a pulse, then it leaves itself unsecured.

**[0009]** Turning to FIG. 1A, a wearable electronic device 100 according to an embodiment includes a housing 102. The housing 102 may take a variety of forms, including a ring, wrist device (e.g., a wristwatch), and a pair of glasses. Within the housing 102 is a pulse sensor 104 (shown with phantom lines). The wearable electronic device 100 according to an embodiment is worn such that the pulse sensor 104 is proximate to a user's skin 106 (shown in FIG. 1B). In some embodiments, the wearable device 100 is paired with a companion device 108. Although shown in FIG. 1B as a smartphone, the companion device 108 may be implemented in a variety of ways, including a tablet computer or a notebook computer.

**[0010]** Turning to FIG. 2, the wearable device 100 in an embodiment includes a processor 202. Several components are communicatively linked to the processor 202, including short-range wireless hardware 204 (e.g., a Bluetooth® chipset or a near-field communication chip), a memory 206, a motion sensor 208 (e.g., an accelerometer), a user interface 210 (e.g., a touch screen, buttons, or knobs), and a display 212 (e.g., an organic light emitting diode watch face). In some embodiments, the display 212 and the user interface 210 are the same physical component. The pulse sensor 104 includes a light source 214 (e.g., a light-emitting diode) and a photo sensor 216. The light source 214 is configured so that it shines light in a direction of a user. In this way, when the wearable device 100 is worn by a user, the light reflects off of the user's skin and is sensed by the photo sensor 216. In some embodiments, the pulse sensor 104 also functions as a proximity sensor. The memory 206 may be volatile, non-volatile, or a combination thereof. In some embodiments, the wearable device 100 also includes wireless networking hardware 218 (e.g., a WiFi chipset or a cellular baseband chipset), through which the wearable device 100 communicates with other devices over networks such as WiFi networks or cellular networks.

**[0011]** The elements of FIG. 2 are communicatively linked to one another via one or more data pathways 220. Possible implementations of the data pathways 220 include wires and conductive pathways on a microchip. Possible implementations of the processor 202 include

a microprocessor and a controller.

**[0012]** Turning to FIG. 3, the companion device 108 in an embodiment includes a processor 302. Several components are communicatively linked to the processor 302, including short-range wireless hardware 304 (e.g., a Bluetooth® chip set or a near-field communication chip), a memory 306, a display 308, and user input devices 310 (e.g., a capacitive touch screen, microphones, and physical buttons). The processor 302 transmits data to and receives data from the wearable device 100 via the short range wireless hardware 304. In some embodiments, the companion device 108 includes wireless networking hardware 314. In those embodiments, the processor 302 sends data to and receives data from other devices via a wireless local area network or a cellular network using the wireless networking hardware 314. The elements of FIG. 3 are communicatively linked to one another via one or more data pathways 312. Possible implementations of the data pathways 312 include wires and conductive pathways on a microchip. Possible implementations of the processor 302 include a microprocessor and a controller. The memory 306 may be volatile, non-volatile, or a combination thereof.

**[0013]** Turning to FIG. 4, operation of the wearable device 100 according to an embodiment is described. In this embodiment, assume that the wearable device 100 is being worn by anyone and is at rest. At block 402, the wearable device 100 checks for motion (e.g., the processor 202 polls the motion sensor 208). If the wearable device 100 does not detect motion, then the process loops back to block 402. If the wearable device 100 detects motion (e.g., the user moves the wearable device off), then the process moves to block 404, at which the wearable device 100 determines whether a pulse is present. For example, the processor 202 turns on the light source 214. The light from the light source reflects off of the user's skin 106. The reflected light is detected by the photo sensor 216. The photo sensor 216 then generates a signal based on the reflected light. The processor 202 reads the signal and determines, based on the signal, whether there is a pulse present (e.g., by using PPG). If the processor 202 determines that there is no pulse present, then the process moves to block 406, at which the processor 202 secures the wearable device 100 (e.g., by ceasing to display texts on the wearable device 100 or by signaling the companion device 108, which reacts by ceasing to send texts to the wearable device 100).

**[0014]** If, at block 404, the wearable device 100 determines that there is a pulse present, the wearable device 100 obtains a baseline reflection profile for the user at block 408. For example, the processor 202 turns on the light source 214. The light from the light source reflects off of the user's skin 106. The reflected light is detected by the photo sensor 216. The photo sensor 216 then generates a signal based on the reflected light. The processor 202 reads the signal and determines, based on the

signal, what the user's skin reflection profile is (e.g., the wavelength at which light from the light source 214 reflects off of the user's skin 106). The skin reflection profile may depend on the user's skin tone and vary from user to user. At block 410, the wearable device 100 sets upper and lower threshold values for the user's skin reflection profile. For example, the processor, based on the user's skin profile, sets upper and lower threshold values for the wavelength (or upper and lower threshold values for the frequency) of the reflected light. At block 412, the wearable device 100 intermittently checks to see whether the user's skin 106 is still in proximity to the wearable device 100. For example, the wearable device flashes the light source 214 intermittently (e.g., every 5 milliseconds). The light from the light source 214 reflects off of the user's skin 106. The reflected light is detected by the photo sensor 216. The photo sensor 216 then generates a signal based on the reflected light. The processor 202 determines whether the wavelength or frequency of the reflected light is within upper and lower thresholds. If so, then the process continues to loop back onto block 412. If not, then the process moves back to block 404.

**[0015]** Turning to FIG. 5, operation of the wearable device 100 according to another embodiment is described. At block 502, the wearable device 100 determines that it is currently being worn based on a first pulse detection operation (e.g., by taking a PPG with the pulse sensor 104 and analyzing the results with the processor 202). At block 504, the wearable device periodically checks for the proximity of the user's skin (e.g., by conducting a proximity detection operation using the components of the pulse sensor 104). In an embodiment, checking for the proximity of the user's skin involves flashing the light source 214 at a power that is less than the power required for the pulse checking operations (e.g., flashing a green light-emitting diode at a lower intensity and for a shorter duration than would be required for taking a PPG). If the wearable device 100 determines that the user's skin is not proximal then, at block 508, the wearable device 100 carries out a second pulse detection operation. If, at block 510, the wearable device 100 detects a pulse in the second pulse detection operation, then the process moves back to block 506. If, on the other hand, the wearable device does not detect a pulse in the second pulse detection operation, the process moves to block 512, at which the wearable device 100 secures itself.

**[0016]** Turning to FIG. 6, operation of the wearable device 100 according to still another embodiment is described. In this embodiment, the wearable device 100 uses pulse detection, but does not necessarily use presence detection. At block 602, the wearable device 100 determines whether a pulse is present (e.g., by taking a PPG with the pulse sensor 104 and analyzing the results with the processor 202). If the wearable device 100 determines that a pulse is present, then the procedure ends. If the wearable device determines that a pulse is not present, the wearable device secures itself at block 604.

**[0017]** While one or more embodiments of the have

been described with reference to the figures, it will be understood by those of ordinary skill in the art that various changes in form and details may be made therein without departing from their scope of as defined by the following claims.

## Claims

1. A method for securing a wearable electronic device (100), the method comprising, on the wearable electronic device:

determining whether the wearable electronic device (100) is currently being worn by a user based on determining whether a pulse of the user is present;  
when the pulse of the user is determined not to be present, securing the wearable electronic device (100); and  
when the pulse of the user is determined to be present:

determining whether the wearable electronic device (100) is still being worn by the user by periodically checking for a proximity of the user's skin to the wearable electronic device (100) without performing a pulse detection operation;  
when, during a periodic check, the user's skin is determined not to be proximal to the wearable electronic device (100), performing a second pulse detection operation; and  
when the second pulse detection operation fails, securing the wearable electronic device (100).

2. The method of claim 1, wherein securing the wearable electronic device (100) comprises locking a user interface (210) of the wearable electronic device.

3. The method of any of claims 1-2, wherein securing the wearable electronic device (100) comprises transmitting a signal to a paired companion device (108) indicating that the wearable electronic device is no longer being worn.

4. The method of any of claims 1-3, wherein determining whether the pulse is present comprises:

acquiring a photoplethysmogram; and  
analyzing the photoplethysmogram.

5. The method of any of claims 1-4, further comprising:

obtaining a baseline reflection profile of the user's skin,  
wherein determining whether the user's skin is

proximal to the wearable electronic device (100) is based on the baseline reflection profile.

6. The method of claim 5, further comprising setting an upper threshold value and a lower threshold value for the baseline reflection profile of the user's skin, wherein determining whether the user's skin is proximal to the wearable electronic device (100) comprises determining whether detected light falls between the upper and lower threshold values.
7. The method of any of claims 1-6, wherein periodically checking for the proximity of the user's skin to the wearable electronic device (100) and determining whether the pulse is present are performed using a same sensor (104) in the wearable electronic device (100).
8. The method of claim 1 or 7, wherein periodically checking for the proximity of the user's skin comprises periodically flashing a light at a power that is less than a power required for a photoplethysmogram.
9. A wearable electronic device (100), comprising:
- a photo sensor (216) configured to generate signals based on sensed light; and
  - a processor (202) configured to:
    - determine whether the wearable electronic device (100) is currently being worn by a user based on determining, based on the signals, whether a pulse of the user is present;
    - when the pulse of the user is determined not to be present, secure the wearable electronic device (100); and
    - when the pulse of the user is determined to be present:
      - determine whether the wearable electronic device (100) is still being worn by the user by periodically checking for a proximity of the user's skin to the wearable electronic device (100) without performing a pulse detection operation;
      - when, during a periodic check, the user's skin is determined not to be proximal to the wearable electronic device (100), perform a second pulse detection operation; and
      - when the second pulse detection operation fails, secure the wearable electronic device (100).
10. The wearable electronic device (100) of claim 9, further comprising a light source (214) that shines light in a direction such that when the wearable electronic

device (100) is worn by the user, the light reflects off of the user and is sensed by the photo sensor (216).

11. The wearable electronic device (100) of any of claims 9-10, wherein the processor (202) is configured to secure the wearable electronic device (100) by locking a user interface (210) of the wearable electronic device (100).
12. The wearable electronic device (100) of any of claims 9-11, wherein the processor (202) is configured to secure the wearable electronic device (100) by transmitting a signal to a paired companion device (108) indicating that the wearable electronic device (100) is no longer being worn.
13. The wearable electronic device (100) of any of claims 9-12, wherein the processor (202) is configured to determine whether the pulse of the user is present at least by:
- acquiring a photoplethysmogram using the photo sensor (216); and
  - analyzing the photoplethysmogram.
14. The wearable electronic device (100) of any of claims 9-13, wherein the processor (202) is further configured to:
- obtain a baseline reflection profile of the user's skin,
  - wherein the processor (202) is configured to determine whether the user's skin is proximal to the wearable electronic device (100) based on the baseline reflection profile.
15. The wearable electronic device (100) of claim 14, wherein the processor (202) is further configured to:
- set an upper threshold value and a lower threshold value for the baseline reflection profile of the user's skin,
  - wherein the processor (202) is configured to determine whether the user's skin is proximal to the wearable electronic device (100) at least by determining whether detected light falls between the upper and lower threshold values.

#### Patentansprüche

1. Verfahren zum Sichern eines tragbaren elektronischen Geräts (100), wobei das Verfahren das Folgende auf dem tragbaren elektronischen Gerät umfasst:
- Bestimmen, ob das tragbare elektronische Gerät (100) gegenwärtig von einem Benutzer ge-

tragen wird, basierend auf dem Bestimmen, ob ein Puls des Benutzers vorhanden ist; wenn bestimmt wird, dass kein Puls des Benutzers vorhanden ist, Sichern des tragbaren elektronischen Geräts (100); und wenn bestimmt wird, dass der Puls des Benutzers vorhanden ist:

- Bestimmen, ob das tragbare elektronische Gerät (100) weiterhin von dem Benutzer getragen wird, durch periodisches Überprüfen, ob sich die Haut des Benutzers in der Nähe des tragbaren elektronischen Geräts (100) befindet, ohne Durchführen eines Pulserfassungsvorgangs; wenn während einer periodischen Überprüfung bestimmt wird, dass sich die Haut des Benutzers nicht in der Nähe des tragbaren elektronischen Geräts (100) befindet, Durchführen eines zweiten Pulserfassungsvorgangs; und wenn der zweite Pulserfassungsvorgang keinen Erfolg zeigt, Sichern des tragbaren elektronischen Geräts (100).
2. Verfahren nach Anspruch 1, wobei das Sichern des tragbaren elektronischen Geräts (100) das Sperren einer Benutzeroberfläche (210) des tragbaren elektronischen Geräts umfasst.
  3. Verfahren nach einem der Ansprüche 1 bis 2, wobei das Sichern des tragbaren elektronischen Geräts (100) das Übertragen eines Signals an ein gepaartes Zusatzgerät (108), das anzeigt, dass das tragbare elektronische Gerät nicht mehr getragen wird, umfasst.
  4. Verfahren nach einem der Ansprüche 1 bis 3, wobei das Bestimmen, ob der Puls vorhanden ist, umfasst:
 

Erhalten eines Photoplethysmogramms; und  
Analysieren des Photoplethysmogramms.
  5. Verfahren nach einem der Ansprüche 1 bis 4, ferner umfassend:
 

Erhalten eines Baseline-Reflexionsprofils der Haut des Benutzers,  
wobei das Bestimmen, ob sich die Haut des Benutzers in der Nähe des tragbaren elektronischen Geräts (100) befindet, auf dem Baseline-Reflexionsprofil basiert.
  6. Verfahren nach Anspruch 5, ferner umfassend das Festsetzen eines oberen Schwellenwerts und eines unteren Schwellenwerts für das Baseline-Reflexionsprofil der Haut des Benutzers, wobei das Bestimmen, ob sich die Haut des Benutzers in der Nähe

des tragbaren elektronischen Geräts (100) befindet, das Bestimmen umfasst, ob erfasstes Licht zwischen den oberen und unteren Schwellenwert fällt.

7. Verfahren nach einem der Ansprüche 1 bis 6, wobei das periodische Überprüfen, ob sich die Haut des Benutzers in der Nähe des tragbaren elektronischen Geräts (100) befindet, und das Bestimmen, ob der Puls vorhanden ist, unter Verwendung desselben Sensors (104) in dem tragbaren elektronischen Gerät (100) durchgeführt werden.
8. Verfahren nach einem der Ansprüche 1 bis 7, wobei das periodische Überprüfen der Nähe der Haut des Benutzers das periodische Aussenden eines Lichts zu einer Energie, die niedriger als die für ein Photoplethysmogramm erforderliche Energie ist, umfasst.
9. Tragbares elektronisches Gerät (100), umfassend:
 

einen Lichtsensor (216), konfiguriert zum Erzeugen von Signalen basierend auf erfasstem Licht; und einen Prozessor (202), der konfiguriert ist:

zu bestimmen, ob das tragbare elektronische Gerät (100) gegenwärtig von einem Benutzer getragen wird, basierend auf dem auf den Signalen basierenden Bestimmen, ob ein Puls des Benutzers vorhanden ist; das tragbare elektronische Gerät (100) zu sichern, wenn bestimmt wird, dass kein Puls des Benutzers vorhanden ist; und wenn bestimmt wird, dass der Puls des Benutzers vorhanden ist:

zu bestimmen, ob das tragbare elektronische Gerät (100) weiterhin von dem Benutzer getragen wird, durch periodisches Überprüfen, ob sich die Haut des Benutzers in der Nähe des tragbaren elektronischen Geräts (100) befindet, ohne einen Pulserfassungsvorgang durchzuführen; einen zweiten Pulserfassungsvorgang durchzuführen, wenn während einer periodischen Überprüfung bestimmt wird, dass sich die Haut des Benutzers nicht in der Nähe des tragbaren elektronischen Geräts (100) befindet; und das tragbare elektronische Gerät (100) zu sichern, wenn der zweite Pulserfassungsvorgang keinen Erfolg zeigt.
10. Tragbares elektronisches Gerät (100) nach Anspruch 9, ferner eine Lichtquelle (214) umfassend, die Licht in eine Richtung ausstrahlt, sodass, wenn das tragbare elektronische Gerät (100) von dem Benutzer getragen wird, das Licht von dem Benutzer

reflektiert und von dem Lichtsensor (216) erfasst wird.

11. Tragbares elektronisches Gerät (100) nach einem der Ansprüche 9 bis 10, wobei der Prozessor (202) konfiguriert ist, das tragbare elektronische Gerät (100) durch Sperren einer Benutzeroberfläche (210) des tragbaren elektronischen Geräts (100) zu sichern.

12. Tragbares elektronisches Gerät (100) nach einem der Ansprüche 9 bis 11, wobei der Prozessor (202) konfiguriert ist, das tragbare elektronische Gerät (100) durch Übertragen eines Signals an ein gepaartes Zusatzgerät (108), das anzeigt, dass das tragbare elektronische Gerät (100) nicht mehr getragen wird, zu sichern.

13. Tragbares elektronisches Gerät (100) nach einem der Ansprüche 9 bis 12, wobei der Prozessor (202) zum Bestimmen des Vorhandenseins des Pulses zumindest anhand des Folgenden konfiguriert ist:

Erhalten eines Photoplethysmogramms unter Verwendung des Lichtsensors (216); und Analysieren des Photoplethysmogramms.

14. Tragbares elektronisches Gerät (100) nach einem der Ansprüche 9 bis 13, wobei der Prozessor (202) ferner konfiguriert ist:

ein Baseline-Reflexionsprofil der Haut des Benutzers zu erhalten, wobei der Prozessor (202) konfiguriert ist, basierend auf dem Baseline-Reflexionsprofil zu bestimmen, ob sich die Haut des Benutzers in der Nähe des tragbaren elektronischen Geräts (100) befindet.

15. Tragbares elektronisches Gerät (100) nach Anspruch 14, wobei der Prozessor (202) ferner konfiguriert ist:

einen oberen Schwellenwert und einen unteren Schwellenwert für das Baseline-Reflexionsprofil der Haut des Benutzers festzulegen, wobei der Prozessor (202) konfiguriert ist, zu bestimmen, ob sich die Haut des Benutzers in der Nähe des tragbaren elektronischen Geräts (100) befindet, zumindest durch das Bestimmen, ob das erfasste Licht zwischen den oberen und unteren Schwellenwert fällt.

## Revendications

1. Procédé de sécurisation d'un dispositif électronique portable (100), le procédé comprenant, sur le dispo-

sitif électronique portable :

la détermination de si le dispositif électronique portable (100) est actuellement porté par un utilisateur sur base de la détermination de la présence ou non d'un pouls de l'utilisateur ; lorsqu'il est déterminé que le pouls de l'utilisateur n'est pas présent, la sécurisation du dispositif électronique portable (100) ; et lorsqu'il est déterminé que le pouls de l'utilisateur est présent :

la détermination de si le dispositif électronique portable (100) est encore porté par l'utilisateur par la vérification périodique d'une proximité de la peau de l'utilisateur par rapport au dispositif électronique portable (100) sans réalisation d'une opération de détection de pouls ; lorsqu'il est déterminé, durant un contrôle périodique, que la peau de l'utilisateur n'est pas proche du dispositif électronique portable (100), la réalisation d'une deuxième opération de détection de pouls ; et lorsque la deuxième opération de détection de pouls échoue, la sécurisation du dispositif électronique portable (100).

2. Procédé selon la revendication 1, dans lequel la sécurisation du dispositif électronique portable (100) comprend le verrouillage d'une interface utilisateur (210) du dispositif électronique portable.

3. Procédé selon l'une quelconque des revendications 1-2, dans lequel la sécurisation du dispositif électronique portable (100) comprend la transmission d'un signal à un dispositif compagnon apparié (108) indiquant que le dispositif électronique portable n'est plus porté.

4. Procédé selon l'une des revendications 1-3, dans lequel la détermination de si le pouls est présent comprend :

l'acquisition d'un photoplethysmogramme ; et l'analyse du photoplethysmogramme.

5. Procédé selon l'une quelconque des revendications 1-4, comprenant en outre :

l'obtention d'un profil de réflexion de base de la peau de l'utilisateur, dans lequel la détermination de si la peau de l'utilisateur est proche du dispositif électronique portable (100) est sur base du profil de réflexion de base.

6. Procédé selon la revendication 5, comprenant en

- outre la définition d'une valeur de seuil supérieure et d'une valeur de seuil inférieure pour le profil de réflexion de base de la peau de l'utilisateur, dans lequel la détermination de si la peau de l'utilisateur est proche du dispositif électronique portable (100) comprend la détermination de si la lumière détectée tombe entre les valeurs de seuil supérieure et inférieure.
7. Procédé selon l'une quelconque des revendications 1-6, dans lequel la vérification périodique de la proximité de la peau de l'utilisateur par rapport au dispositif électronique portable (100) et la détermination de si le pouls est présent sont effectuées à l'aide d'un même capteur (104) dans le dispositif électronique portable (100).
8. Procédé selon la revendication 1 ou 7, dans lequel la vérification périodique de la proximité de la peau de l'utilisateur comprend le clignotement périodique d'une lumière à une puissance inférieure à la puissance requise pour un photopléthysmogramme.
9. Dispositif électronique portable (100), comprenant :
- un photodétecteur (216) configuré pour générer des signaux sur base de la lumière détectée ; et
  - un processeur (202) configuré pour :
    - déterminer si le dispositif électronique portable (100) est actuellement porté par un utilisateur sur base de la détermination, sur base des signaux, de si un pouls de l'utilisateur est présent ;
    - lorsqu'il est déterminé que le pouls de l'utilisateur n'est pas présent, sécuriser le dispositif électronique portable (100) ; et
    - lorsqu'il est déterminé que le pouls de l'utilisateur est présent :
      - déterminer si le dispositif électronique portable (100) est encore porté par l'utilisateur par la vérification périodique d'une proximité de la peau de l'utilisateur par rapport au dispositif électronique portable (100) sans réalisation d'une opération de détection de pouls ;
      - lorsqu'il est déterminé, durant un contrôle périodique, que la peau de l'utilisateur n'est pas proche du dispositif électronique portable (100), réaliser une deuxième opération de détection de pouls ; et
      - lorsque la deuxième opération de détection de pouls échoue, sécuriser le dispositif électronique portable (100).
10. Dispositif électronique portable (100) selon la revendication 9, comprenant en outre une source de lumière (214) qui émet de la lumière dans une direction telle que lorsque le dispositif électronique portable (100) est porté par l'utilisateur, la lumière se réfléchit sur l'utilisateur et est détectée par le photodétecteur (216).
11. Dispositif électronique portable (100) selon l'une quelconque des revendications 9-10, dans lequel le processeur (202) est configuré pour sécuriser le dispositif électronique portable (100) par le verrouillage d'une interface utilisateur (210) du dispositif électronique portable (100).
12. Dispositif électronique portable (100) selon l'une quelconque des revendications 9-11, dans lequel le processeur (202) est configuré pour sécuriser le dispositif électronique portable (100) par la transmission d'un signal à un dispositif compagnon apparié (108) indiquant que le dispositif électronique portable (100) n'est plus porté.
13. Dispositif électronique portable (100) selon l'une quelconque des revendications 9-12, dans lequel le processeur (202) est configuré pour déterminer si le pouls de l'utilisateur est présent au moins par :
- l'acquisition d'un photopléthysmogramme en utilisant le capteur photoélectrique (216) ;
  - et l'analyse du photopléthysmogramme.
14. Dispositif électronique portable (100) selon l'une quelconque des revendications 9-13, dans lequel le processeur (202) est en outre configuré pour :
- obtenir un profil de réflexion de base de la peau de l'utilisateur,
  - dans lequel le processeur (202) est configuré pour déterminer si la peau de l'utilisateur est proche du dispositif électronique portable (100) sur base du profil de réflexion de base.
15. Dispositif électronique portable (100) selon la revendication 14, dans lequel le processeur (202) est en outre configuré pour :
- définir une valeur de seuil supérieure et une valeur de seuil inférieure pour le profil de réflexion de base de la peau de l'utilisateur,
  - dans lequel le processeur (202) est configuré pour déterminer si la peau de l'utilisateur est proche du dispositif électronique portable (100) au moins par la détermination de si la lumière détectée tombe entre les valeurs de seuil supérieure et inférieure.

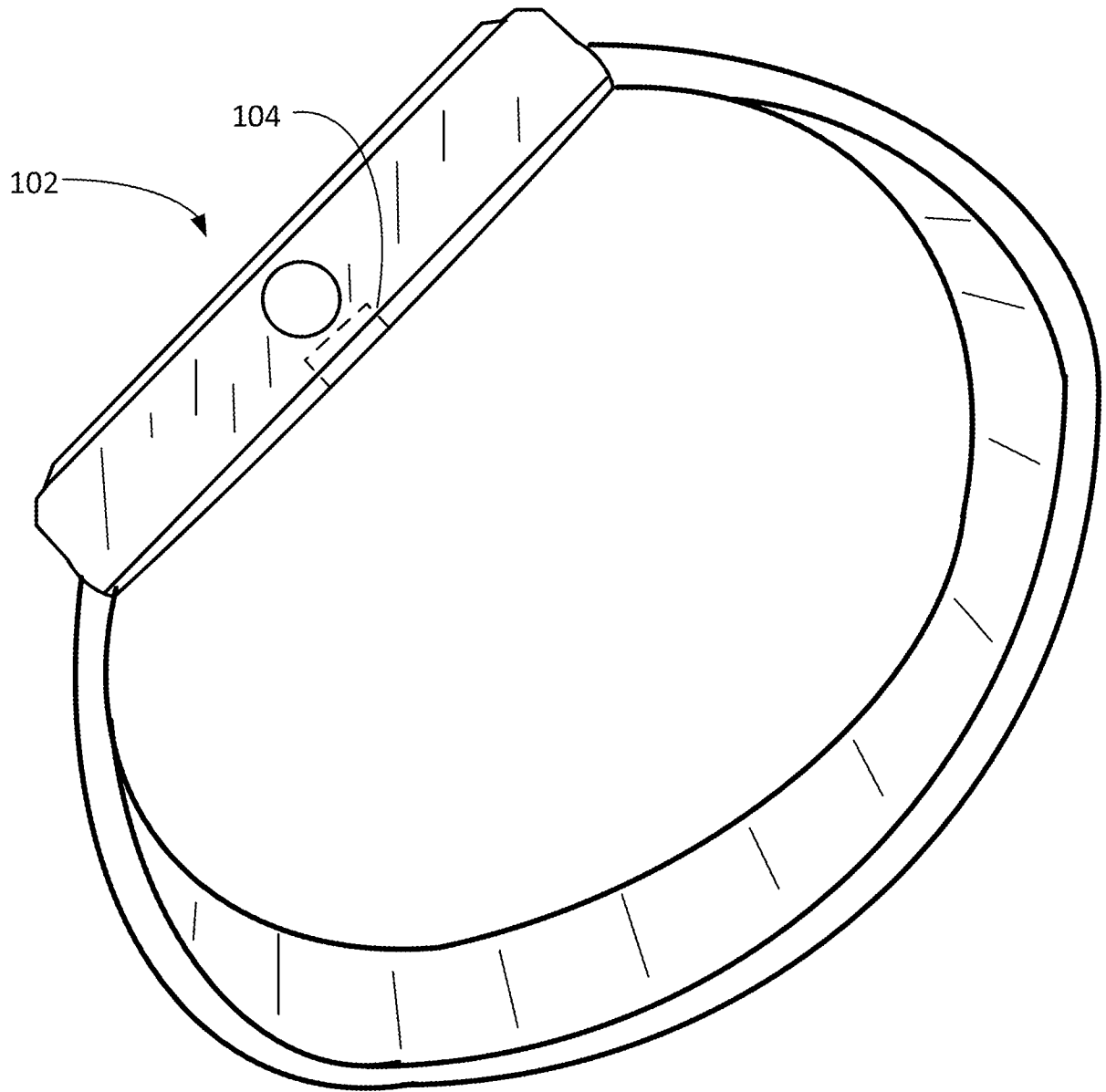


FIG. 1A



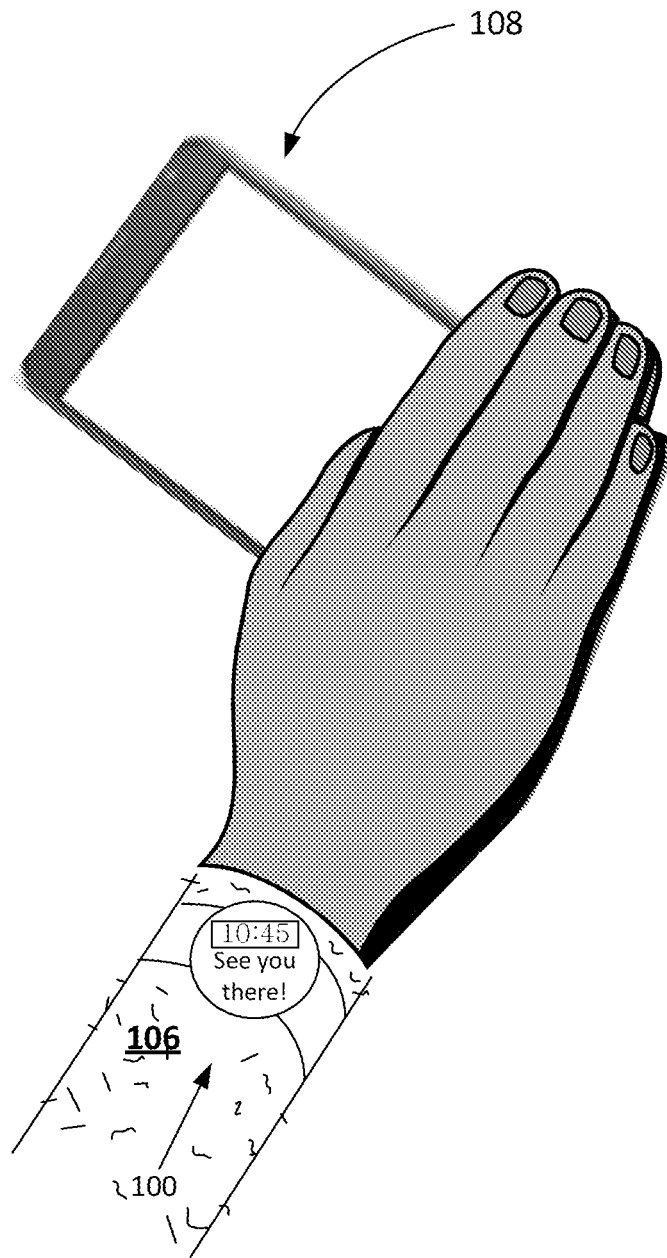


FIG. 1B

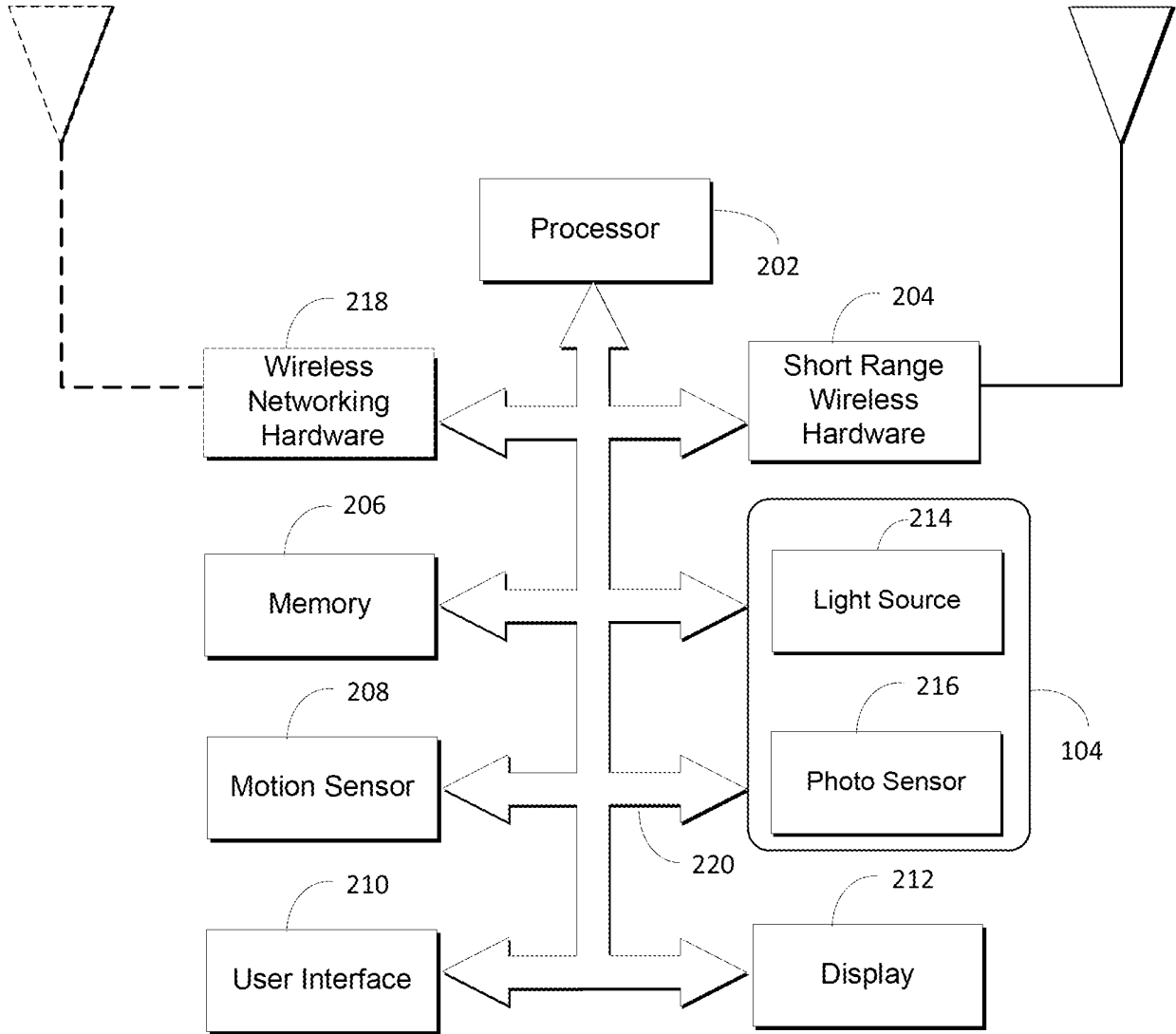


FIG. 2

100

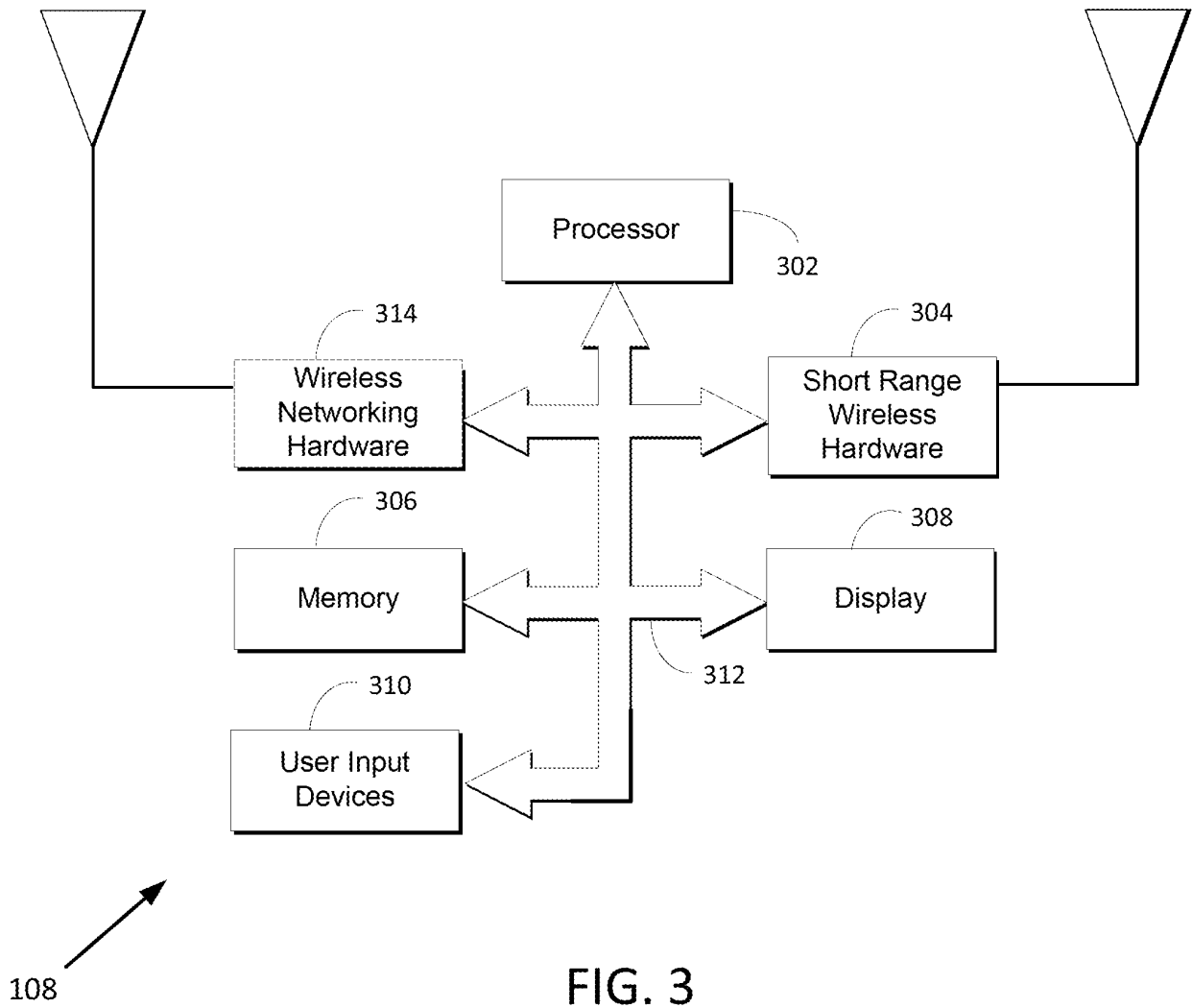


FIG. 3

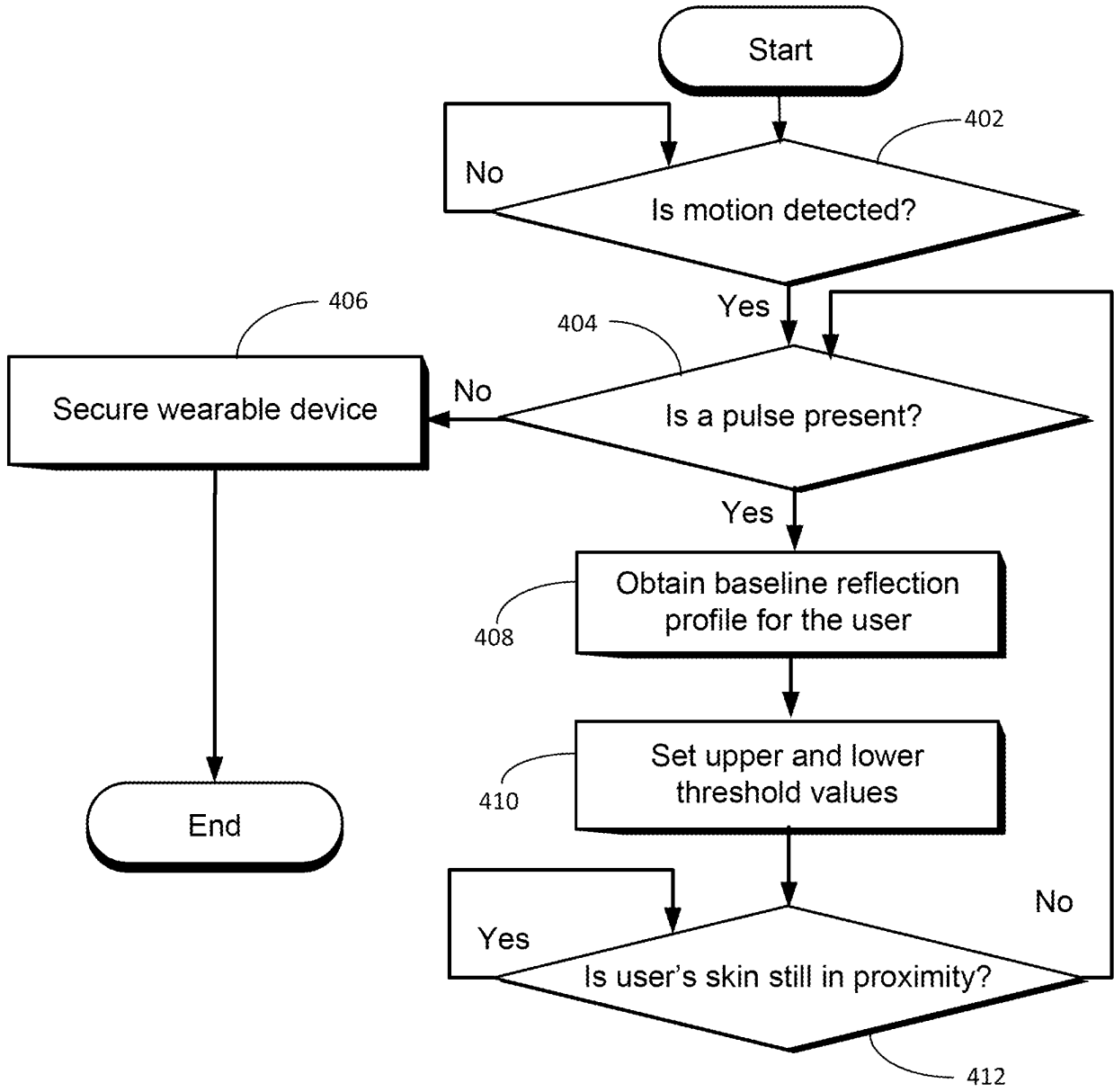


FIG. 4

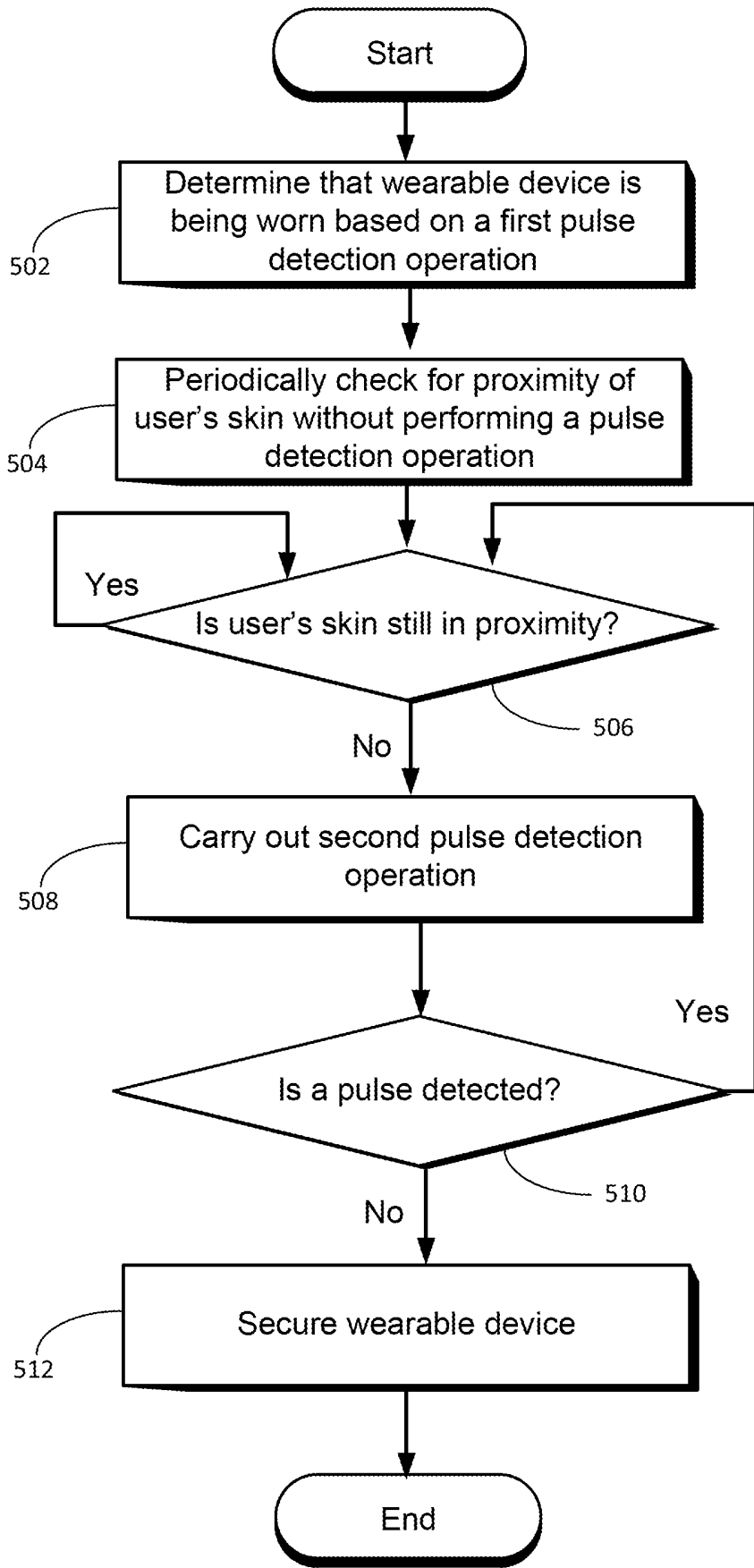


FIG. 5

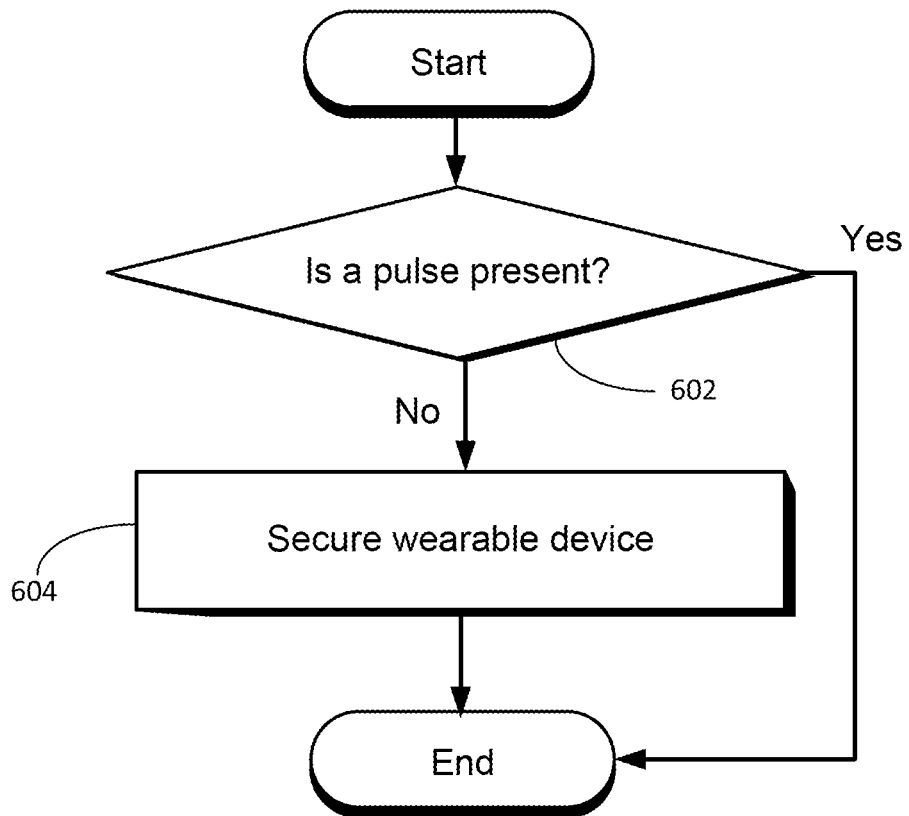


FIG. 6

|                |   |         |            |
|----------------|---|---------|------------|
| 专利名称(译)        | 可穿戴电子设备及其固定方法   |         |            |
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| [标]申请(专利权)人(译) | 谷歌技术控股有限责任公司  |         |            |
| 申请(专利权)人(译)    | Google技术控股有限责任公司  |         |            |
| 当前申请(专利权)人(译)  | Google技术控股有限责任公司  |         |            |
| [标]发明人         | PATEL MITUL R<br>DALVI SAJID I<br>KUZHIYIL FRANCIS X<br>TASHAKKOR ERIC V  |         |            |
| 发明人            | PATEL, MITUL, R.<br>DALVI, SAJID, I.<br>KUZHIYIL, FRANCIS, X.<br>TASHAKKOR, ERIC, V.                                  |         |            |
| IPC分类号         | G06F21/32 G06F21/34 G06F21/35 H04L29/06 H04W12/06 A61B5/00  |         |            |
| CPC分类号         | A61B5/0002 A61B5/681 A61B5/6898 G06F21/32 G06F21/34 G06F21/35 H04L63/0853 H04L63/0861 H04W12/06 H04W12/0605 G06F21/44 |         |            |
| 代理机构(译)        | 博尔特WADE TENNANT   |         |            |
| 优先权            | 62/016375 2014-06-24 US<br>14/464837 2014-08-21 US  |         |            |
| 其他公开文献         | EP3161707B1   |         |            |
| 外部链接           | <a href="#">Espacenet</a>   |         |            |

#### 摘要(译)

本公开涉及一种可穿戴设备，其被配置为基于从脉冲传感器接收的信号来保护自身。根据一种实施方式，脉冲传感器包括光源（例如，发光二极管）和光传感器。在控制器的控制下，光源照射具有特定波长（例如，绿色或红外）的光。光电传感器根据感应的光产生信号。例如，当来自光源的光从人的皮肤反射时，光传感器将基于光传感器检测到的反射光产生信号。以这种方式，可穿戴设备可以准确地确定它是否被用户佩戴（例如，通过拍摄光容积描记图），并且在必要时，确保可穿戴电子设备的安全。