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(54) Title: ELECTRONIC LOCK WITH WIRELESS CONTROL

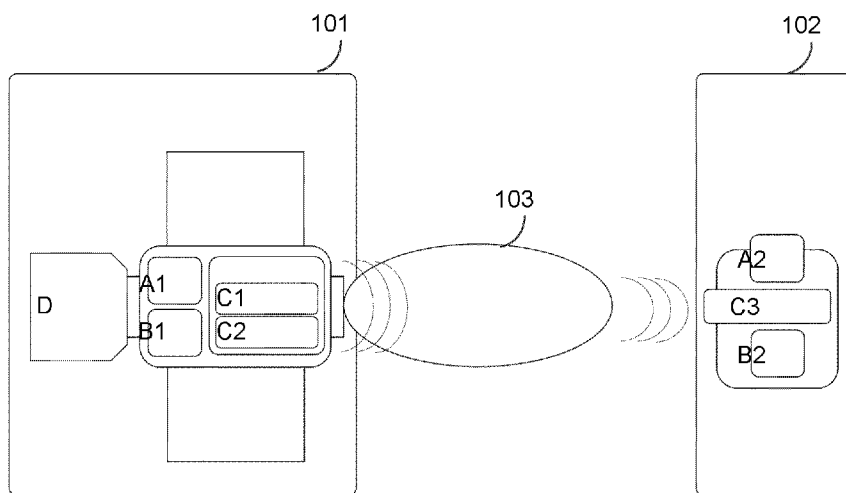


FIG. 1

(57) Abstract: The method and system for access control, comprising detecting, by the electronic lock a tactile action by a body on a tactile sensor. The electronic lock transmitting a first signal using very low frequency band in response to said detection of tactile action through said body. The electronic key fob receives the first electromagnetic signal, where the first signal is transmitted through a body in contact with a transmitter of said first electromagnetic signal i.e. the electronic lock. Further, the electronic key fob transmits a second electromagnetic signal in response to receipt of said first electromagnetic signal. The electronic lock receives the second signal in response to said first signal and disengages or engages a lock in response to said received second signal.



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**Title**

## ELECTRONIC LOCK WITH WIRELESS CONTROL

**Field**

5 The present disclosure relates to a method and system for access control and interaction/activity monitoring. More specifically the present disclosure relates to locking or unlocking of a door or an entrance or provides access to a user.

**Background**

10 It is well known that radio frequency key fobs are used for granting access e.g. by opening a door. A user is required to press a lock/unlock button and such an action causes the key fob to transmit or establish communication with the access controller. If the key fob is duly authorized by the access controller, access is granted to the user. Hence, a user is required to press a button to  
15 activate the key fob to begin the process of gaining access. This may be cumbersome and difficult in scenarios where both of the user's hands are busy e.g. holding shopping bags, etc. Therefore, it is desirable to have a method and system which overcomes the above problem.

20 A person skilled in the art would appreciate that devices based on capacitive or inductive coupling either require a wearable or an implant. However, such limitations cause additional inconvenience to a user. Further, air-gaps between the key fob and the body shall have a huge impact on the performance of the device when based on capacitive or inductive coupling.

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WO2010/067390 discloses communications between a mobile device and a fixed device using a single bidirectional channel where the human body is an extension of the receiver antenna.

30 Numerous other patent publications exist in the art for providing an access control system in which a door controller, reader or lock or the like communicates with a mobile key (or fob) via RF signals. For example, European patent publication number EP 2 608 158 discloses a system with Intrabody and

RF communications between a biometric reader and a wearable/portable device. This system relies on intrabody capacitive communication so that capacitive coupling is used for the intrabody communication, where direct contact is mentioned when interacting with the reader device and also when  
5 describing the wearable device. French patent publication number FR3022092 discloses a system that uses a combination of Near Field Communications (NFC) and RF communications. US patent number US5,796,827 is another device that is based on the contact or close proximity for operation resulting in a very limited distance due to contact or coupling to perform communications.

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Hence, there is an unresolved need for a method and system for access control which solves the above mentioned technical problems of the art.

### **Summary**

15 The present invention, as set out in the appended claims, is directed to a method and system for access control. The system for access control comprises an electronic lock and an electronic key fob.

In one embodiment the electronic lock comprises means for detecting a tactile  
20 action by a user's body on a tactile sensor/conductive element, means for transmitting a first signal through said body in response to said detection of tactile action, means for receiving a second signal in response to said first signal and means for disengaging or engaging a lock in response to said received second signal. The first signal is transmitted through the body wherein  
25 said body causes said tactile action.

The means for transmitting the first signal comprises a very low frequency wireless transceiver (VLF/LF) and the body acts as an antenna and/or transmission media for transmitting said first signal.

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The means for receiving the second signal comprises an ultra high frequency or a super high frequency wireless transceiver. In an embodiment means for

receiving the second signal comprises a Bluetooth (TM) protocol transceiver or any other suitable RF technology system.

The present invention uses a multi radio approach for access control  
5 communications between a reader and a remote device (wearable/portable) whereas one of the signals, used as wake up command ID, travels through the human body and reaches the remote device, enabling a secondary radio communications. The secondary communication channel is typically a SHF or UHF signal.

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Suitably the method and system of the invention uses the body as an extended antenna for transmission of the wake up command ID when in contact with the reader. This signal used for body communications is VLF/LF. The human body irradiates a very short range field that is picked up by the wearable/portable  
15 device through a resonant receiver. Using this approach the range of the portable device can be extended to a portable device that the user may carry in a bag, handbag or backpack and not just the typical wearable device like a watch.

20 In one embodiment the electronic key fob comprises means for receiving a first electromagnetic signal in the very low or low frequency bands (VLF/LF), said first signal transmitted through a body in contact with a transmitter of said first electromagnetic signal and means for transmitting a second electromagnetic signal in response to receipt of said first electromagnetic signal. The means for  
25 receiving the first signal comprises a very low or low frequency (VLF/LF) wireless transceiver. The means for transmitting the second signal comprises an ultra high frequency or a super high frequency wireless transceiver. In an embodiment the means for transmitting the second signal comprises a Bluetooth(TM) protocol transceiver or any other suitable RF technology system.

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In one embodiment the method comprises the steps of detecting, by the electronic lock a tactile action by a body on a tactile sensor and the electronic lock transmitting a first signal using very low frequency band (VLF/LF) in

response to said detection of tactile action through said body. The electronic key fob receives the first electromagnetic signal, where the first signal is transmitted through a body in contact with a transmitter of said first electromagnetic signal i.e. the electronic lock.

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In one embodiment the electronic lock is a lock for a car or vehicle door or boot of a car or vehicle.

Further, the electronic key fob transmits a second electromagnetic signal in response to receipt of said first electromagnetic signal. The electronic lock receives the second signal in response to said first signal and disengages or engages a lock in response to said received second signal. The second signal is an ultra high frequency electromagnetic signal or a super high frequency electromagnetic signal.

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It will be appreciated that the invention does not focus on new cyphering methods. The invention makes use of the Bluetooth protocol security and adds an extra layer by using a secondary unique ID that triggers the Bluetooth communications to happen in a very short range. The system and method of the invention is more secure in the sense that a portable device is effectively off (deep sleep) until the touch event occurs. Through the touch event a VLF/LF signal is transmitted through the human body on contact with the reader. Until this wake-up signal is received, the portable device is on standby, without broadcasting any information on Bluetooth or any other radio, like other prior art devices do for proximity detection.

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In one embodiment a RF communication interface module is provided configured for the primary wake-up signal that allows the secondary bidirectional communication to occur. The frequencies used can vary from 1Hz to 150kHz (LF/VLF), being around 25kHz to 30kHz in most use cases. Prior art systems that claimed intrabody communications, work in the LF domain only (usually 125-150kHz). By reducing the frequencies to the VLF domain, around or below 30kHz, it was proven that a tighter control of distance, due to amount

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of field radiated by the body in relation to lower frequencies resulting in longer wavelengths to be achieved.

In one embodiment a RF communication interface module is provided, on the receiver side (portable device), and comprises the capability of using one, two or three antennae elements. In this case by strategic physical placement of the same, the receiver is able to discriminate the direction in which the field has been received. This information can add valuable information about the relative placement and orientation of the device in relation to the target to avoid false triggers that may occur, for example by placing the receiver too close to the reader from the inside of an access controlled door/gate, in such a way that a touch event from the outside could, with some sort of passive amplification, allow the receiver to wake-up and perform an unintended successful authentication event, granting access to a user that should not be granted access.

In one embodiment the invention can use Bluetooth or Sub-Giga RF (e.g.433MHz) or any other RF technology for short range bidirectional communication and authentication. In this case the RF communication interface relates to the secondary signal mentioned above whereas secure authentication occurs to grant access to the user. In the case of Bluetooth, typical 2.4Ghz is the frequency used. In the case of using Sub-Giga RF communications the frequencies may vary depending on the licensing of the ISM spectrum in determined geographical regions. Sub-GiGa RF operates in the ISM spectrum bands below 1Ghz - typically in the 769 - 935 MHz, 315 Mhz and the 468 Mhz frequency range. This spectrum band below 1Ghz is particularly useful for RF IOT applications.

Thereby, the present invention provides a method and system for access control which overcomes the problems identified above while also being able to monitor activities and/or interactions between the technology enabled device and the end user that carries the portable device.

There is also provided a computer program comprising program instructions for causing a computer program to carry out the above method which may be embodied on a record medium, carrier signal or read-only memory.

5 **Brief Description of the Drawings**

The invention will be more clearly understood from the following description of an embodiment thereof, given by way of example only, with reference to the accompanying drawings, in which:-

10 FIG. 1 exemplarily illustrates the components of a system for access control;

FIG. 2 is a functional block diagram exemplarily illustrating the primary components of the system for access control; and

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FIG. 3 is a flowchart of the method for access control, according to one embodiment of the invention.

**Detailed Description of the Drawings**

20 The present invention is directed to a method and system for access control. FIG. 1 exemplarily illustrates the components of a system for access control. The system for access control comprises an electronic lock 101 and an electronic key fob 102. A predefined signal (with certain modulation and encoding) is generated by the electronic lock 101 and transmitted through a  
25 conductive element, which may be a cylinder of the electronic lock 101. In order to lock or unlock the electronic lock 101, a user touches an exposed portion of the electronic lock 101, which causes the predefined signal to travel through the user's body 103. In other words the user's body acts as an antenna and/or medium for the transmission of the predefined signal depending on the location  
30 of the receiver device. The predefined signal is received by an electronic key fob 102 placed in close proximity to the user's body (pocket, pendant, belt, or in a backpack or handbag carried by the user). When in close proximity to the body, e.g. pocket, it can be considered that body coupling between the user and

the portable device occurs; however, when within a certain distance from the users body, e.g. backpack, the receiver is able to read the electromagnetic signal that the human body irradiates, behaving like an antenna.

5 Once the predefined signal is received by electronic key fob 102, the electronic key fob 102 wakes up a secondary encrypted and secured radio which then performs the necessary communication with the electronic lock 101 which results in an actuation event to occur e.g. the electronic lock actuates a lever to allow access to a door. For this secondary radio, i.e. Bluetooth, different levels  
10 of authentication can be implemented as required by the end application, while also taking advantage of the RSSI of the received signal to identify the distance at which the user might be from the lock that is trying to unlock in order to discriminate from false and/or unintentional events.

15 FIG. 2 is a functional block diagram exemplarily illustrating the primary components of the system for access control.

The electronic lock 101, comprises a touch controller C1, a conductive element coupled to a very low frequency (VLF/LF) transmitter C2, a Bluetooth (TM) low  
20 energy (BLE) module A1 and an electro-mechanical actuation device D. The conductive element in cooperation with the touch controller C1 detects a tactile action by a user's body 103 on the conductive element. Once the tactile action is detected, the VLF/LF transmitter coupled to the conductive element, transmits a first signal through said user's body i.e. the body acts as an antenna for  
25 transmitting said first signal. A second signal is received by the BLE module A1 in response to said first signal and an electro-mechanical actuation device D disengages or engages a lock in response to said received second signal. In an embodiment the first signal is transmitted by a very low frequency wireless transceiver. In another embodiment, the second signal receiving means  
30 comprises an ultra high frequency or a super high frequency wireless transceiver.

The electronic key fob 102, comprises a VLF/LF transceiver C3 for receiving a first electromagnetic signal in the very low and low frequency band, said first signal transmitted through a body in contact with a transmitter of said first electromagnetic signal and a BLE module A2 for transmitting a second electromagnetic signal in response to receipt of said first electromagnetic signal.  
5 The VLF/LF transceiver C3 comprises an antenna/ae, amplifier, a narrow bandpass filter and a VLF/LF RF receiver and/or homodyne SDR, where the VLF/LF transceiver is configured to detect or receive the transmitted first signal. This can be achieved through a very simple SDR implemented at a  
10 microcontroller level using homodyne detection, but also through any custom or integrated instrumentation discrete solution.

In an embodiment, the electronic key fob 102 comprises an ultra high frequency or a super high frequency wireless transceiver for transmitting the second  
15 signal. In an embodiment the means for transmitting the second signal comprises a Bluetooth(TM) protocol transceiver.

The working of the above components is described in detail in the following paragraphs.

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The conductive element in communication with the touch controller wakes up for a few milliseconds every second from a standby state to poll for a touch event to occur. Once, a tactile action is detected on the conductive element/tactile sensor i.e. once a user touches the conductive element of the electronic lock  
25 101 using his/her fingers a tactile action is detected.

Once a tactile action is detected, the VLF/LF oscillator or a VLF/LF transceiver wakes up and transmits a VLF/LF modulated signal comprising a predefined identifier of the electronic lock 101. The VLF/LF modulated signal via the  
30 conductive element travels through the body of the user who is in direct contact with the conductive element of the electronic lock 101. The VLF/LF transceiver C3 of the electronic key fob 102 receives the VLF/LF modulated signal. In other words, the electronic lock 101 transmits a first signal using very low frequency

band in response to said detection of tactile action through said body 103. The electronic key fob 102 receives the first electromagnetic signal, where the first signal is transmitted through a user's body 103 in contact with a transmitter of said first electromagnetic signal i.e. the conductive element of the electronic lock 101.

The electronic key fob 102 further verifies as to whether the electronic key fob 102 matches with the electronic lock 101 by comparing the received identifier of the electronic lock 101. Upon successful verification, the Bluetooth module A2 of the electronic key fob 102 wakes up to transmit lock engage/disengage signal to the Bluetooth module A1 of the electronic lock 101. A person skilled in the art would appreciate that the electronic lock 101 and the electronic key fob 102 are previously paired. In other words, the electronic key fob transmits a second electromagnetic signal in response to receipt of said first electromagnetic signal.

The electronic lock receives the second electromagnetic signal in response to said first signal and disengages or engages a lock in response to said received second signal. The second signal is an ultra high frequency electromagnetic signal or a super high frequency electromagnetic signal.

FIG. 3 is a flowchart of the method for access control. As disclosed above, the method comprises detecting 301, by the electronic lock a tactile action by a body on a tactile sensor. The electronic lock transmitting 302 a first signal using very low frequency band in response to said detection of tactile action through said body. The electronic key fob receives the first electromagnetic signal, where the first signal is transmitted through a body in contact with a transmitter of said first electromagnetic signal i.e. the electronic lock. Further, the electronic key fob transmits a second electromagnetic signal in response to receipt of said first electromagnetic signal. The electronic lock receives 303 the second signal in response to said first signal and disengages or engages 304 a lock in response to said received second signal.

Further, a person ordinarily skilled in the art will appreciate that the various illustrative logical/functional blocks, modules, circuits, and process steps

described in connection with the embodiments disclosed herein may be implemented as electronic hardware, or a combination of hardware and software. To clearly illustrate this interchangeability of hardware and a combination of hardware and software, various illustrative components, blocks, 5 modules, circuits, and steps have been described above generally in terms of their functionality. Whether such functionality is implemented as hardware or a combination of hardware and software depends upon the design choice of a person ordinarily skilled in the art. Such skilled artisans may implement the described functionality in varying ways for each particular application, but such 10 obvious design choices should not be interpreted as causing a departure from the scope of the present invention.

The process described in the present disclosure may be implemented using various means. For example, the apparatus described in the present disclosure 15 may be implemented in hardware, firmware, software, or any combination thereof. For a hardware implementation, the processing units, or processors(s) or controller(s) may be implemented within one or more application specific integrated circuits (ASICs), digital signal processors (DSPs), digital signal processing devices (DSPDs), programmable logic devices (PLDs), field 20 programmable gate arrays (FPGAs), processors, controllers, micro-controllers, microprocessors, electronic devices, other electronic units designed to perform the functions described herein, or a combination thereof.

For a firmware and/or software implementation, software codes may be stored 25 in a memory and executed by a processor. Memory may be implemented within the processor unit or external to the processor unit. As used herein the term "memory" refers to any type of volatile memory or non-volatile memory.

In the specification the terms "comprise, comprises, comprised and comprising" 30 or any variation thereof and the terms include, includes, included and including" or any variation thereof are considered to be totally interchangeable and they should all be afforded the widest possible interpretation and vice versa.

The invention is not limited to the embodiments hereinbefore described but may be varied in both construction and detail.

**Claims**

1. A method for access control, comprising:
  - detecting a tactile action by a body on a tactile sensor;
  - 5 transmitting a first signal in response to said detection of tactile action through said body wherein the first signal is a very low frequency / low frequency (VLF/LF) electromagnetic signal;
  - receiving a second signal in response to said first signal; and
  - disengaging or engaging a lock in response to said received second
  - 10 signal.
  
2. The method of claim 1 wherein said first signal is transmitted through the body wherein said body causes said tactile action.
  
- 15 3. The method of claim 1 or 2 wherein said body acts as an antenna and/or conductive media for transmitting said first signal.
  
4. The method of any preceding claim wherein the second signal is an ultra high frequency electromagnetic signal or a super high frequency electromagnetic
- 20 signal.
  
5. The method of claim 4 wherein the second signal complies with Bluetooth(TM) protocol or a suitable RF technology system.
  
- 25 6. A method for access control, comprising:
  - receiving a first electromagnetic signal in very low frequency / low frequency band, said first signal transmitted through a body in contact with a transmitter of said first electromagnetic signal; and
  - transmitting a second electromagnetic signal in response to receipt of said
  - 30 first electromagnetic signal.
  
7. The method of claim 6 further comprising disengaging or engaging a lock in response to said second electromagnetic signal received by said lock.

8. The method of claim 6 or 7 wherein the second signal is an ultra high frequency electromagnetic signal or a super high frequency electromagnetic signal.

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9. The method of any of claims 6, 7 or 8 wherein the second signal complies with Bluetooth (TM) protocol or a suitable RF technology system.

10. An electronic lock, comprising:

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means for detecting a tactile action by a body on a tactile sensor;

means for transmitting a first signal through said body in response to said detection of tactile action;

means for receiving a second signal in response to said first signal; and

means for disengaging or engaging a lock in response to said received

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second signal.

11. The electronic lock of claim 10 wherein means for transmitting the first signal comprises a very low frequency wireless transceiver.

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12. The electronic lock of claims 10 or 11 wherein said first signal is transmitted through the body wherein said body causes said tactile action.

13. The electronic lock of any of claims 10 to 13 wherein said body acts as an antenna for transmitting said first signal.

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14. The electronic lock of any of claims 10 to 13 wherein means for receiving the second signal comprises an ultra high frequency or a super high frequency wireless transceiver.

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15. The electronic lock of any of claims 10 to 14 wherein means for receiving the second signal comprises a Bluetooth(TM) protocol transceiver.

16. An electronic key fob, comprising:

means for receiving a first electromagnetic signal in the very low frequency /  
low frequency band, said first signal transmitted through a body in contact  
with a transmitter of said first electromagnetic signal; and

5 means for transmitting a second electromagnetic signal in response to  
receipt of said first electromagnetic signal.

17. The electronic key fob of claim 16 wherein means for receiving the first  
signal comprises a very low frequency wireless transceiver.

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18. The electronic key fob of claim 16 or 17 wherein means for transmitting the  
second signal comprises an ultra high frequency or a super high frequency  
wireless transceiver.

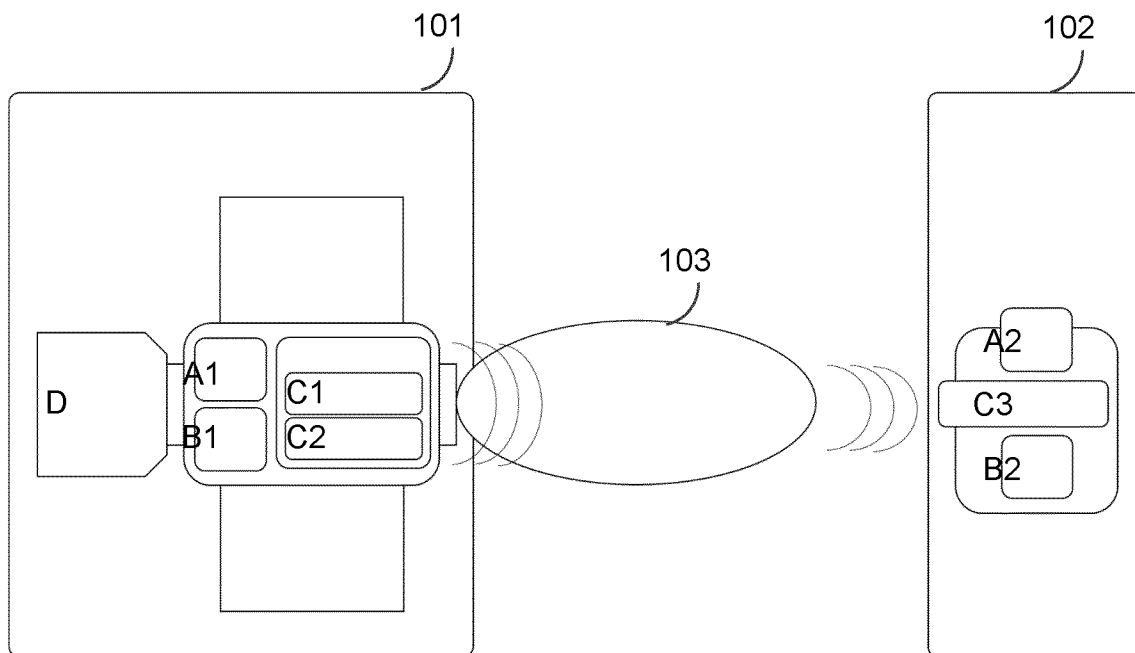
15 19. The electronic key fob of any of claims 16, 17 or 18 wherein means for  
transmitting the second signal comprises a Bluetooth (TM) protocol transceiver  
or a suitable RF technology system.

20. A system for access control, comprising:

20 an electronic lock as claimed in any one of claims 10  
-15; and

an electronic key fob as claimed in any one of claims 16-19.

**Drawings**



**FIG. 1**

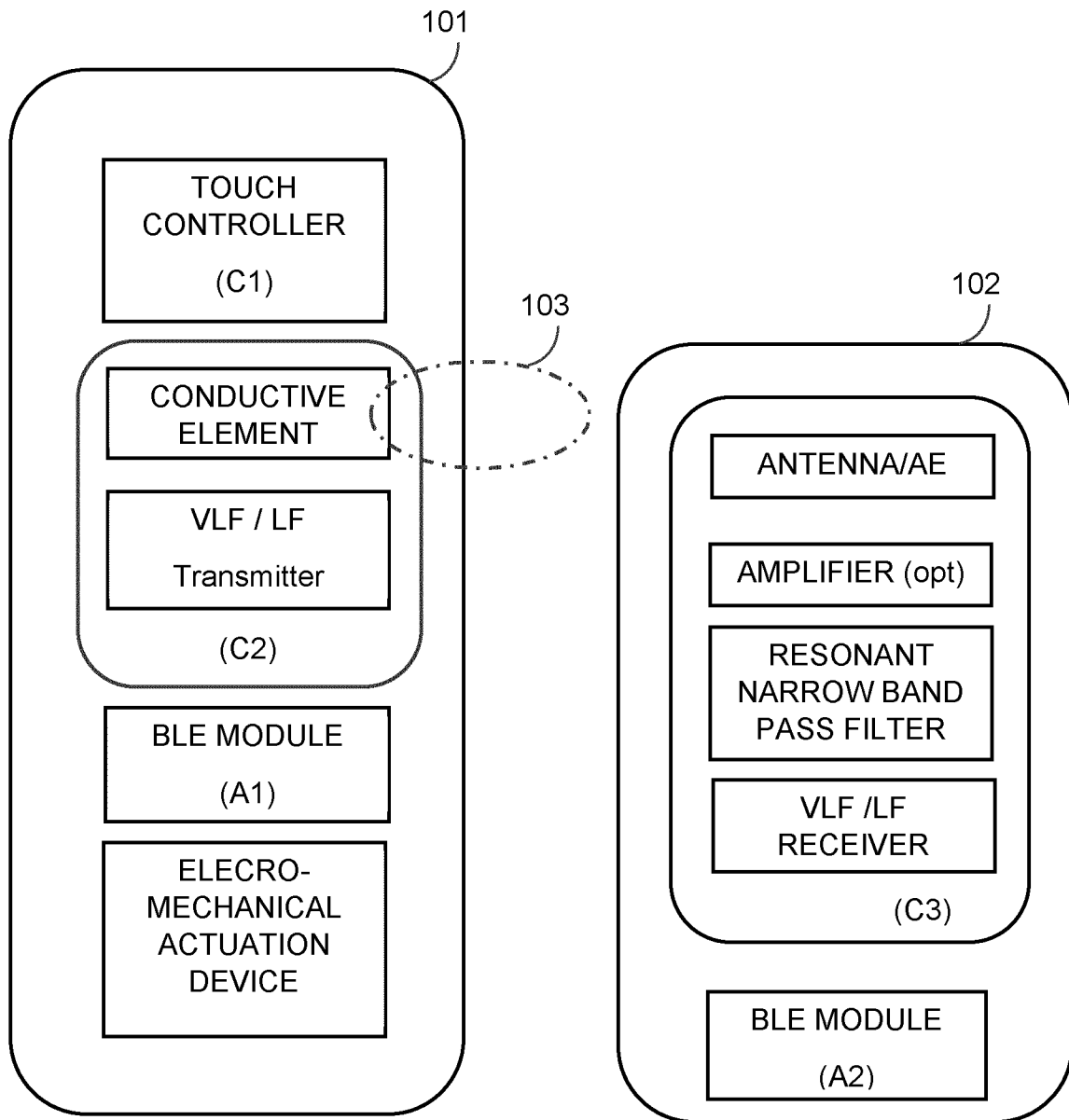


FIG. 2

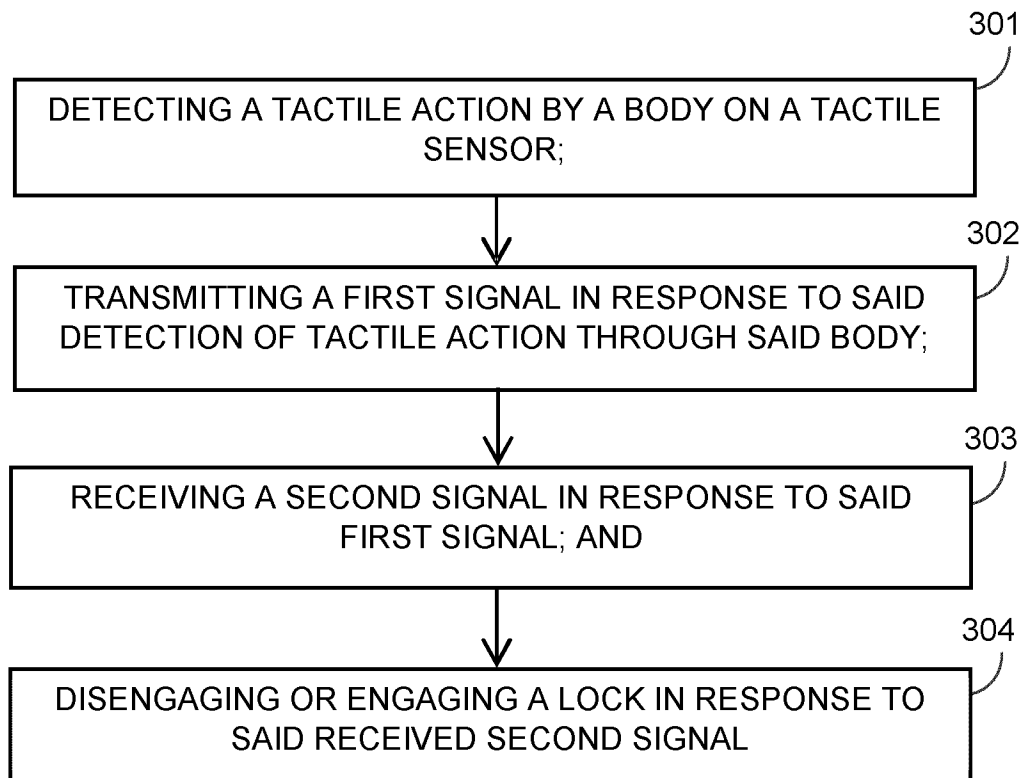


FIG. 3

INTERNATIONAL SEARCH REPORT

International application No  
PCT/EP2020/058976

A. CLASSIFICATION OF SUBJECT MATTER  
 INV. G07C9/00 B60R25/20  
 ADD. H04B13/00

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)  
 G07C

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)  
 EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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Y	page 1, line 1 - line 3 page 1, line 23 - line 26 page 3, line 15 - line 18 page 3, penultimate line - page 4, line 2 page 5, line 9 - line 12 page 5, line 24 - line 32 page 6, line 23 - line 24 page 6, line 32 ----- -/--	17

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 June 2020	Date of mailing of the international search report  26/06/2020
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Name and mailing address of the ISA/ European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Authorized officer  Verhoof, Paul
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## INTERNATIONAL SEARCH REPORT

International application No  
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C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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A	US 5 204 672 A (BROOKS JAMES E [US]) 20 April 1993 (1993-04-20)  paragraphs [0054], [0057], [0082] -----	4,5,8,9, 11,14, 15,17-19

# INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

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