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Remarks:
Amended claims in accordance with Rule 137(2) EPC.

(54) **DIELECTRIC WAVEGUIDE DATA INTERFACE AND SENSOR SYSTEM**

(57) Dielectric waveguide data interface and sensor system, comprising a dielectric waveguide and a radio transceiver attached to a first end of the dielectric waveguide. The radio transceiver comprises an electronic circuit, configured to generate a radar signal and/or a communication signal, and a coupling element, configured to couple the radar signal and/or the communication signal into the dielectric waveguide.

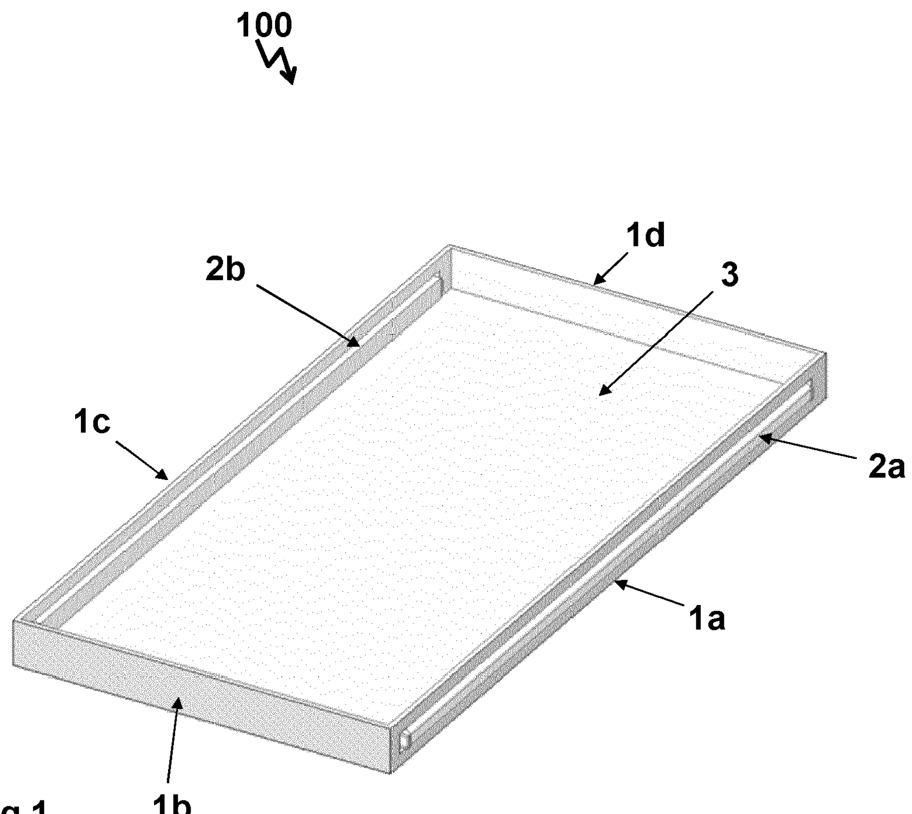

Fig.1

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Description

Technical Field

[0001] The present invention relates to a high-speed data interface and sensor system for IOT devices. In particular, the present invention relates to a dielectric waveguide data interface and sensor system, a mobile phone comprising such by the electric waveguide data interface and sensor system, several uses of such a system, a method of data transfer between two mobile devices, a method of sensing and positioning of an element in the environment of an IOT device using such a system or such a mobile phone, a program element and a computer-readable medium.

Background

[0002] Portable devices such as tablets, smart phones and smart watches have become popular recently due to the rapid advancement and low cost semi-conductor technologies. Portable devices as well as other electronic devices may incorporate antenna elements for radiofrequency (RF) communication as well as for radar applications such as object ranging, tracking and identification. In some applications, multiple antenna elements may be utilized for beamforming, transmit diversity and multiple input, multiple output (MIMO) configurations, and also as radar sensors that can detect user motions, also known as gesture sensors.

[0003] As portable devices become smaller and device functionalities expanded, it may be difficult to fit additional antennas within the device front-side or back-side while still providing the desired functionality. Many portable devices use wireless communication to transmit and receive large amounts of data. For example, personal videos and photographs through air-interfaces to, for example, cloud services. In other applications, for example, for system update, also large amounts of sensitive data have to be transferred.

[0004] However, privacy may not be guaranteed in such a procedure, because the data transfer through air-interfaces may be detected by other radio devices that receive the data without permission.

[0005] Further, portable devices may also need to acquire information about objects in their vicinity, such as sliding motions of fingers.

Summary

[0006] It is an object of the present invention to provide a portable device, which is capable of sensing objects or providing data transmission capabilities.

[0007] This object is solved by the subject matter of the independent claims. Further embodiments are the subject of the dependent claims and the following disclosure.

[0008] A first aspect of the present disclosure relates to a dielectric waveguide data interface and sensor system, which comprises one or more dielectric waveguides and one or more radio transceivers attached to a first end of the respective dielectric waveguide. The radio transceiver comprises an electronic circuit, which is configured to generate a radar signal and/or a communication signal. A coupling element is provided, which is configured to couple the radar signal and/or the communication signal into the dielectric waveguide.

[0009] This may provide for fast short range communication capabilities and object detection capabilities in close vicinity of a dielectric waveguide data interface and sensor system, i.e., in close vicinity of the dielectric waveguide.

[0010] The dielectric waveguide data interface and sensor system provides alternative means of data exchange and can be manufactured at relatively low cost.

[0011] Portable devices, such as mobile phones, may also need to acquire information about objects on the side area of the mobile phone. The same applies to smart watches or other electronic devices, which may need to detect a finger position or providing an operating signal, gliding motions of fingers, the heart beat signal of a person or animal, or for shutting the device off when it is laid out of hands, for example.

[0012] The dielectric waveguide data interface and sensor system according to the present disclosure is capable of acquiring information about objects on the side area of a device and can be manufactured at low cost, at the same time improving functionality and increasing resilience and privacy of the device.

[0013] In the following, the IOT and mobile devices may be referred to supportable devices or, as a placeholder, mobile phones. In accordance with an embodiment of the present disclosure, a radio frequency system includes dielectric waveguides in the side region of the portable device.

[0014] The dielectric waveguides are coupled to high-frequency circuits (electronic circuits) and may provide two functions: injecting electromagnetic waves into the dielectric waveguide and sensing electromagnetic waves coming from the dielectric waveguide.

[0015] The dielectric waveguide may be constructed to carry electromagnetic waves partly inside the waveguide and partly outside the waveguide.

[0016] High-frequency transceivers (radio transceivers) are attached to the ends of the dielectric waveguides to transmit and receive electromagnetic waves to and from the dielectric waveguides, respectively. The high-frequency transceivers are connected to the signal processing circuits of the portable device providing and receiving digital data for exchange between the portable device and other IOT devices, or to transmit and receive electrical signals from the immediate vicinity of the portable device.

[0017] According to an embodiment, the electronic circuit and the coupling element are arranged on a transceiver substrate.

[0018] According to another embodiment, the dielectric waveguide data interface and sensor system further comprises a load element attached to a second end of the dielectric waveguide, wherein the load element is configured to absorb the radar signal after is has passed from the first end of the dielectric waveguide to the second end of the dielectric waveguide.

[0019] According to another embodiment, the load element is a radio transceiver.

[0020] According to another embodiment, the dielectric waveguide is filled with an outer dielectric material in which a channel formed of an inner dielectric material is embedded. The inner dielectric material is configured to guide the radar signal from the first end of the dielectric waveguide to the second end of the dielectric waveguide. The inner dielectric material has a higher or lower dielectric constant than the outer dielectric material.

[0021] For example, the outer dielectric material has a dielectric constant which is higher than one 1.5, or even higher than 2.

[0022] Another aspect of the present disclosure relates to a mobile phone or another hand-held device, such as a tablet or a smart watch, comprising a first dielectric waveguide data interface and sensor system, as disclosed above and in the following.

[0023] The mobile phone comprises, according to another embodiment, at least a second dielectric waveguide data interface and sensor system, such as described above and below, which is in the vicinity, i.e. adjacent to the first dielectric waveguide data interface and sensor system. These two may be arranged in a row.

[0024] Another aspect of the present disclosure relates to the use of a dielectric waveguide data interface and sensor system, such as disclosed above and below, for data transfer between mobile devices or between a mobile device and a stationary device, or even between two stationary devices.

[0025] Another aspect of the present disclosure relates to the use of such a dielectric waveguide data interface and sensor system or a mobile phone as health sensor.

[0026] Another aspect of the present disclosure relates to the use of such a dielectric waveguide data interface and sensor system or a mobile phone as material sensor.

[0027] A still further use relates to a dielectric waveguide data interface and sensor system or a mobile phone as length sensor.

[0028] A further aspect relates to a method of data transfer, i.e. data transmission, between two mobile devices, in which both mobile devices are arranged side-by-side and data is transmitted between the two mobile devices or, more specifically, from one device to the other, using the above and below described dielectric waveguide data interface and sensor system.

[0029] The method may further comprise the steps of applying a modulation scheme of a high-frequency signal when transmitting the data, and applying a demodulation scheme of the high-frequency signal when receiving the data (by the other device).

[0030] A further aspect of the present disclosure relates to a method of sensing and positioning of an element in the environment, i.e. vicinity, of an IOT device using the above and below described dielectric waveguide data interface and sensor system or the above and below described mobile phone, for example by using a pulse radar method to detect reflected pulses from dielectric waveguide, or a frequency modulated radar method to detect reflected frequency spectrum from dielectric waveguide.

[0031] A further aspect of the present disclosure relates to the use of the above and below described dielectric waveguide data interface and sensor system for blood pressure detection by placing dielectric waveguide data interface and sensor system next to a human body and detecting reflected radar signals from at least two dielectric waveguides and calculate pulse wave speed for deriving blood pressure value.

[0032] A further aspect of the present disclosure relates to a program element which, when being executed by a processor of a dielectric waveguide data interface and sensor system or of a mobile device, such as a mobile phone, instructs the dielectric waveguide data interface and sensor system or the mobile device to perform the following steps: transmitting data between two mobile devices using the dielectric waveguide data interface and sensor system; sensing and positioning an element in an environment of an IOT device.

[0033] A further aspect of the present disclosure relates to a computer-readable medium on which the above described program element is stored.

[0034] A computer-readable medium may be a floppy disk, a hard disk, a CD, a DVD, an USB (Universal Serial Bus) storage device, a RAM (Random Access Memory), a ROM (Read Only memory) and an EPROM (Erasable Programmable Read Only Memory). A computer readable medium may also be a data communication network, e.g. the Internet, which allows downloading a program code.

[0035] The terms used in the claims should be construed to have the broadest reasonable interpretation consistent with the foregoing description. For example, the use of the article "a" or "the" in introducing an element should not be interpreted as being exclusive of a plurality of elements. Likewise, the recitation of "or" should be interpreted as being inclusive, such that the recitation of "A or B" is not exclusive of "A and B," unless it is clear from the context or the foregoing description that only one of A and B is intended. Further, the recitation of "at least one of A, B and C" should be interpreted as one or more of a group of elements consisting of A, B and C, and should not be interpreted as requiring at least one of each of the listed elements A, B and C, regardless of whether A, B and C are related as categories or otherwise. Moreover, the recitation of "A, B and/or C" or "at least one of A, B or C" should be interpreted as including any singular entity from the listed elements, e.g., A, any subset from the listed elements, e.g., A and B, or the entire list of elements A, B and C.

[0036] In the following, further embodiments of the present disclosure are described with reference to the Figures. If the same reference numerals are used in different Figures, they denote similar or corresponding elements. The drawings and the Figures are schematic and not to scale.

Brief description of the Figures

[0037]

Fig. 1 shows a schematic view of the housing of a mobile phone comprising 4 dielectric waveguides placed in the side walls.

Fig. 2 shows a top view of the mobile phone of Fig. 1 in a user's hand.

Fig. 3 shows a top view of two mobile phones placed next to each other with touching dielectric waveguides.

Fig. 4 shows a dielectric waveguide data interface and sensor system with radio transceiver and load element placed at the ends of the dielectric waveguide.

Fig. 5 shows a cross-section through a dielectric waveguide.

Fig. 6 shows a schematic view of a radio transceiver.

Fig. 7 shows a flow chart of data transfer process according to embodiment.

Fig. 8 shows a flow chart of blood pressure measurement process according to an embodiment.

Detailed description of embodiments

[0038] Fig. 1 shows a perspective view of the housing of a mobile phone with four dielectric waveguides placed in the side walls. Seen from the outside, the mobile phone consists of the backplane 3 the display (not shown) and four side walls 1a-1d. According to the invention, there are several dielectric waveguide systems 2a, 2b placed in the side walls 1a and 1c. Because of the construction of the waveguide systems, they are touch sensitive and the position of a touch can be detected.

[0039] Fig. 2 shows a top view of the mobile phone 100 in a user's hand. Visible are the fingers of the hand holding the mobile phone 100 with thumb 10, index finger 11, middle finger 12 and ring finger 13. The fingers are touching the dielectric waveguides with transceivers 2a and 2b. Because the waveguide systems 2a, 2b are touch sensitive, the position of the fingers can be detected and can be used as input signals for the mobile phone 100. Not only can the position of the fingers be detected, but also the movement of the fingers. For example, finger tapping can be a special form of input signals. Or, sliding of one finger can be used as input signal for loudness control. An advantage of this type of input operation is the possibility of one-hand operation of the mobile phone.

[0040] One of the two mobile devices, e.g. mobile phones, may also be a charging station, for example in a vehicle, or a tablet, or a display. In an embodiment, magnets may be provided at the edges of the devices to facilitate firm contact between the two devices and to hold them together.

[0041] Fig. 3 shows a top view of two mobile phones 100a and 100b placed near to each other so that some of the waveguide systems 2a, 2b are touching each other. Because of the construction of the waveguide systems 2a-2b, electromagnetic energy is outside the waveguide systems 2a, 2b and electrical coupling between them occurs. Therefore, it is possible to transfer electrical signals from one waveguide system to the other and this can be used for information transfer from first mobile phone 100 to second mobile phone 100' or vice versa. This type of information exchange has the advantage that it is very secure, since no information is emitted into the air, but only a coupling takes place in the extremely close range between the waveguide systems 2a, 2b of the two mobile phones. In addition, the information can be transmitted at a very high data rate, since the signals can be very broadband because no frequency regulations have to be observed since there is nearly no emission into the air.

[0042] Fig. 4 shows a schematic view of a waveguide system with radio transceiver 5 and load element 6 placed at the ends of dielectric waveguide 4. The waveguide systems 2a, 2b consists of a dielectric waveguide 4 and radio transceiver 5 placed at the one end of dielectric waveguide 4 and a load element 6 placed at the other end of dielectric waveguide 4. The radio transceiver 5 is a high frequency electronic device with coupler structure capable of transmitting and receiving high frequency signals. The operation frequency in Millimeter wave range or in Terahertz range. This means, frequency is between 30 GHz and 3 THz or above. Higher frequency has the advantage of more compact construction because of shorter wavelength and hence smaller coupler size and smaller diameter of waveguide systems 2a and 2b. The radio transceiver 5 and load element 6 are glued to the ends of dielectric waveguide 4 or fixed to dielectric waveguide 4 with other means. The load element 6 consists of absorbing material and it prevents reflections from the end point of dielectric waveguide 4.

[0043] Fig. 5 shows the cross section through dielectric waveguide 4. The dielectric waveguide 4 consists of at least two materials with different dielectric constants. The rod-shaped construction of dielectric waveguide 4 can take many forms. For example, the dielectric waveguide 4 is composed of inner material 21 and outer material 22. Important is that the materials are insulators and have different dielectric constants epsilon1 and epsilon2 so that the waveguide can carry an electric wave. In most of the cases epsilon1 is greater than epsilon2. However, it can also be the other way around, for example it is possible that the inner material 21 consists of air and the outer material 22 consists of plastic or glass.

[0044] Fig. 6 shows schematic view of a radio transceiver 5. It consists of the transceiver substrate 31, an electronic circuit 32 and a coupling element 33. The transceiver substrate 31 is preferably a semiconductor material, for example monocrystalline Silicon. The coupling element 33 consists of metal and can have the shape of a rectangle forming a so-called patch-antenna. However other substrate materials for example Indium-Phosphide (InP) can also be used. For simplicity, a monolithic integrated transceiver is shown in the Fig. 6. However, also other integration methods are possible, for example two or more chip-solution, hybrid integration and different ICpackages can be used. Also, the coupling element 33 can radiate to top-direction or through transceiver substrate 31 to the down-direction. The radio transceiver 5 is connected to other circuitry of the mobile phone 100 for example the main processor for data exchange. The electronic circuit 32 has the task of processing the data coming from processor or to deliver data to the processor. And the electronic circuit 32 has the task of generating high-frequency signals and providing them to the dielectric waveguide 4 via coupling element 33 or to receive and process signals coming from dielectric waveguide 4 via coupling element 33.

[0045] There are two modes of operation: The first mode is the communication mode and the second mode is the sensing mode. In the following sections, the sensing mode is described first and the communication mode is described second.

[0046] In sensing mode, the radio transceiver 5 is acting similar to a common radar transceiver with the difference that in mobile phone 100 the generated radar signals from radio transceiver 5 go to dielectric waveguide 4 and in common radar it will go to air. Radar signals are well-known. Radar signals can be pulse signals or modulated high-frequency continuous wave signals. One example is the use of high frequency carrier at 300 GHz with linear frequency ramps of high bandwidth for example 50 GHz bandwidth to ensure sufficient local resolution. The signal in form of electromagnetic wave is coupled to dielectric waveguide 4 and the reflected signal is detected in radio transceiver 5. This procedure is known as FMCW radar (Frequency Modulated Continuous Wave). The reflection depends on environment of the dielectric waveguide 4. If the dielectric waveguide 4 is not touched, there will be no reflection because the load element 6 absorbs the electromagnetic wave at the end of dielectric waveguide 4. If something (for example a finger) touches the dielectric waveguide 4, then a reflection consisting of electromagnetic wave travelling back towards the radio transceiver 5 is generated. The time delay of transmission and receiving of electromagnetic wave is measured and the result is further processed. Because the time delay mentioned is depending on distance between radio transceiver 5 and the finger touching the dielectric waveguide 4. Hence, the exact position of the finger is detected. Not only position of one finger can be detected, but also position of several fingers. Similar to FMCW radar operation in air, the reflectivity spectrum over the whole length of the dielectric waveguide 4 can be estimated. Usually, this is performed in FMCW radar with FFT signal processing (FFT - Fast Fourier Transformation). Similarly, if pulse radar principle is used the reflectivity properties over the whole length of the dielectric waveguide 4 can be estimated as well and hence, a plurality of touching points can be detected and its location can be determined. The functional principle can be pulse correlation basing on two slightly different pulse repetition frequencies f_{PRF1} and f_{PRF2} which trigger the TX and LO oscillators whereby their pulses drift apart from each other and so the measurement range is sequentially sampled. Another functional principle can be pulse correlation basing on controlled delay-elements in receive path to generate well-defined delay series corresponding to distance in dielectric waveguide 4.

[0047] Additional to the positioning of an object touching the dielectric waveguide 4, also the contact pressure of soft surfaces can be measured. This can be used for different interesting use-cases. For example, when touching the dielectric waveguide 4 with a finger, the heart rate can be detected. Still more sensitive is the method of heart rate detection and heart sound detection when touching the dielectric waveguide 4 with an arm or with any other part of the body where a large pulse movement is palpable.

[0048] In communication mode, two portable devices e.g. mobile phones are placed side by side as shown in Figure 3. The placement is such that at least one dielectric waveguide 4 of the first mobile phone 100 touches at least one dielectric waveguide 4 of the second mobile phone 100'. It is assumed that the first mobile phone 100 should transmit information to the second mobile phone 100'. The radio transceiver 5 of the first mobile phone 100 transmits modulated high-frequency signal to waveguide system 2a. Because of touching dielectric waveguides, some of electromagnetic power carrying information is transferred to waveguide system 2b'.

[0049] Figure 7 illustrates in more detail the process of data transfer. It shows an example of a flow chart to perform data transfer process. It is an embodiment of communication mode of two portable devices e.g. mobile phones.

[0050] The boxes along the vertical line indicate the steps to initiate and execute data exchange between two mobile phones. In the first step 201, a manual or automatic command is given to mobile phone 100 to synchronize data with another mobile phone 100'. In second step 202 the two mobile phones are placed side by side as shown in Figure 3 so that the dielectric waveguide 4 of the first mobile phone 100 touches dielectric waveguide 4 of the second mobile phone 100'. From step 201 it is known that the first mobile phone 100 should transmit information to the second mobile phone 100'. In third step 203, the radio transceiver 5 of the mobile phone 100' is activated in receive mode. In step 204, the radio transceiver 5 of the first mobile phone 100 transmits data in form of modulated high-frequency signal to waveguide system 2a. Because of touching dielectric waveguides, some of electromagnetic power carrying information is transferred to waveguide system 2b' in step 205. In step 206, the transferred data is stored in memory of mobile phone 100'.

[0051] Figure 8 shows a flow chart of blood pressure measurement process using mobile phone 100. In step 301, the command for blood pressure measurement is given manually or according to health schedule of the user. This will activate the sensing mode in step 302. In step 303, the mobile phone 100 is placed to human body at a spot on the body with a good pulse amplitude, for example at the wrist. The mobile phone 100 is placed parallel to the forearm in such a way that one of the dielectric waveguides 4 rests on the skin surface along its entire length. In step 304, the movement of the skin surface along the length of dielectric waveguides 4 is measured. The movement of skin surface includes the pulse wave of periodic blood transport toward the hand of the user. The measurement is performed by rapidly determining the reflection conditions at all locations of the dielectric waveguide 4 and storing -in step 305- the results in memory. The measurement frequency can be in the range of some measurements per second till 1000 measurements per second. After a certain time of some seconds or few tens of seconds, the stored information will be evaluated in step 306. Evaluation includes pulse shape and pulse wave velocity. The pulse shape will give indication for systolic to diastolic pressure ratio and pulse wave velocity will give indication for absolute values of blood pressure. In step 307, the blood pressure values are available and will be displayed and/or stored in memory of mobile phone 100.

List of Reference Signs

[0052]

100	housing of a mobile phone with two dielectric waveguide systems
1a - 1d	side walls of mobile phone
2a - 2d	waveguide systems
3	back panel
4	dielectric waveguide
5	radio transceiver
6	load element
10	thumb
11	index finger
12	middle finder
13	ring finger
21	inner material
22	outer material
31	transceiver substrate
32	electronic circuirt
33	coupling element
200	flow chart of data transfer process
300	flow chart of blood pressure measurement process

Claims

1. Dielectric waveguide data interface and sensor system (2), comprising:

   a dielectric waveguide (4);
   a radio transceiver (5) attached to a first end of the dielectric waveguide;
   wherein the radio transceiver comprises:

      an electronic circuit (32), configured to generate a radar signal and/or a communication signal;
      a coupling element (33), configured to couple the radar signal and/or the communication signal into the dielectric waveguide.

2. Dielectric waveguide data interface and sensor system (2) according to claim 1,
   wherein the electronic circuit (32) and the coupling element (33) are arranged on a transceiver substrate (31).

3. Dielectric waveguide data interface and sensor system (2) according to one of the preceding claims, further comprising:

   a load element (6) attached to a second end of the dielectric waveguide;
   wherein the load element is configured to absorb the radar signal after it has passed from the first end of the dielectric waveguide to the second end of the dielectric waveguide.

4. Dielectric waveguide data interface and sensor system (2) according to claim 3,
   wherein the load element (6) is a radio transceiver.

5. Dielectric waveguide data interface and sensor system (2) according to one of the preceding claims,

   wherein the dielectric waveguide (4) is filled with an outer dielectric material (22) in which a channel formed of an inner dielectric material (21) is embedded;
   where the inner dielectric material is configured to guide the radar signal from the first end of the dielectric waveguide to the second end of the dielectric waveguide;
   where the inner dielectric material has a higher

or lower dielectric constant than the outer dielectric material.

6. Dielectric waveguide data interface and sensor system (2) according to claim 5, wherein the outer dielectric material has a dielectric constant which is higher than 1.5.

7. Dielectric waveguide data interface and sensor system (2) according to one of the preceding claims, comprising at least two dielectric waveguides (4) and being configured to calculate a pulse wave speed in a vessel for deriving a blood pressure value

8. Mobile phone (100), comprising a first dielectric waveguide data interface and sensor system (2) according to one of the preceding claims.

9. Mobile phone (100) according to claim 8, comprising at least a second dielectric waveguide data interface and sensor system (2) according to one of claims 1 to 7 adjacent to the first dielectric waveguide data interface and sensor system (2).

10. Use of a dielectric waveguide data interface and sensor system (2) according to one of claims 1 to 7 for data transfer between two mobile devices or between a mobile device and a stationary device.

11. Use of a dielectric waveguide data interface and sensor system (2) according to one of claims 1 to 7 or a mobile phone (100) according to claim 8 or 9 as health sensor.

12. Use of a dielectric waveguide data interface and sensor system (2) according to one of claims 1 to 7 or a mobile phone (100) according to claim 8 or 9 as material sensor.

13. Use of a dielectric waveguide data interface and sensor system (2) according to one of claims 1 to 7 or a mobile phone (100) according to claim 8 or 9 as length sensor.

14. Method of data transfer between two mobile devices, comprising the steps of:

    arranging both mobile devices side-by-side;
    transmitting data between the two mobile devices using a dielectric waveguide data interface and sensor system (2) according to one of claims 1 to 7.

15. Method of claim 14, comprising the steps of:

    applying a modulation scheme of a high frequency signal when transmitting the data;
    applying a demodulation scheme of the high frequency signal when receiving the data.

16. Method of sensing and positioning of an element in the environment of an IoT device using a dielectric waveguide data interface and sensor system (2) according to one of claims 1 to 7 or a mobile phone (100) according to claim 8 or 9.

17. Program element, which, when being executed by a processor of a dielectric waveguide data interface and sensor system (2) according to one of claims 1 to 7 or a mobile phone (100) according to claim 8 or 9, instructs the dielectric waveguide data interface and sensor system to perform at least one of the following steps:

    transmitting data between two mobile devices using the dielectric waveguide data interface and sensor system;
    sensing and positioning an element in an environment of an IoT device.

18. Computer-readable medium on which a program element according to claim 17 is stored.

Amended claims in accordance with Rule 137(2) EPC.

1. Mobile device, comprising a dielectric waveguide data interface and sensor system (2), comprising:

    a dielectric waveguide (4);
    a radio transceiver (5) attached to a first end of the dielectric waveguide;
    wherein the radio transceiver comprises:

        an electronic circuit (32), configured to generate a radar signal and/or a communication signal;
        a coupling element (33), configured to couple the radar signal and/or the communication signal into the dielectric waveguide;

    wherein the dielectric waveguide data interface and sensor system is touch sensitive and configured to detect the position of fingers touching the waveguide; and/or
    wherein the dielectric waveguide data interface and sensor system is configured to transfer information from the dielectric waveguide data interface and sensor system to a second dielectric waveguide data interface and sensor system touching it.

2. Mobile device according to claim 1, wherein the electronic circuit (32) and the coupling element (33) are arranged on a transceiver substrate

(31).

3. Mobile device according to one of the preceding claims, further comprising:

a load element (6) attached to a second end of the dielectric waveguide;
wherein the load element is configured to absorb the radar signal after it has passed from the first end of the dielectric waveguide to the second end of the dielectric waveguide.

4. Mobile device according to claim 3,
wherein the load element (6) is a radio transceiver.

5. Mobile device according to one of the preceding claims,

wherein the dielectric waveguide (4) is filled with an outer dielectric material (22) in which a channel formed of an inner dielectric material (21) is embedded;
where the inner dielectric material is configured to guide the radar signal from the first end of the dielectric waveguide to the second end of the dielectric waveguide;
where the inner dielectric material has a higher or lower dielectric constant than the outer dielectric material.

6. Mobile device according to claim 5,
wherein the outer dielectric material has a dielectric constant which is higher than 1.5.

7. Mobile device according to one of the preceding claims, comprising at least two dielectric waveguides (4) and being configured to calculate a pulse wave speed in a vessel for deriving a blood pressure value, when one of the dielectric waveguides rests on the skin surface along its entire length and the movement of the skin surface along the length of dielectric waveguides is measured..

8. Mobile device according to one of the preceding claims, wherein the mobile device is a monbile phone (100).

9. Mobile phone (100) according to claim 8, comprising at least a second dielectric waveguide data interface and sensor system (2) according to one of claims 1 to 7 adjacent to the first dielectric waveguide data interface and sensor system (2).

10. Use of a mobile device according to one of claims 1 to 7 for data transfer between two mobile devices or between the mobile device and a stationary device.

11. Use of a mobile device according to one of claims 1 to 7 or a mobile phone (100) according to claim 8 or 9 as health sensor.

12. Use of a mobile device according to one of claims 1 to 7 or a mobile phone (100) according to claim 8 or 9 as material sensor.

13. Use of a mobile device according to one of claims 1 to 7 or a mobile phone (100) according to claim 8 or 9 as length sensor.

14. Method of data transfer between two mobile devices, comprising the steps of:

arranging both mobile devices side-by-side;
transmitting data between the two mobile devices using a mobile device according to one of claims 1 to 7.

15. Method of claim 14, comprising the steps of:

applying a modulation scheme of a high frequency signal when transmitting the data;
applying a demodulation scheme of the high frequency signal when receiving the data.

16. Method of sensing and positioning of an element in the environment of an IoT device using a mobile device according to one of claims 1 to 7 or a mobile phone (100) according to claim 8 or 9.

17. Program element, which, when being executed by a mobile device according to one of claims 1 to 7 or a mobile phone (100) according to claim 8 or 9, instructs the dielectric waveguide data interface and sensor system to perform at least one of the following steps:

transmitting data between two mobile devices using the dielectric waveguide data interface and sensor system;
sensing and positioning an element in an environment of an IoT device.

18. Computer-readable medium on which a program element according to claim 17 is stored.

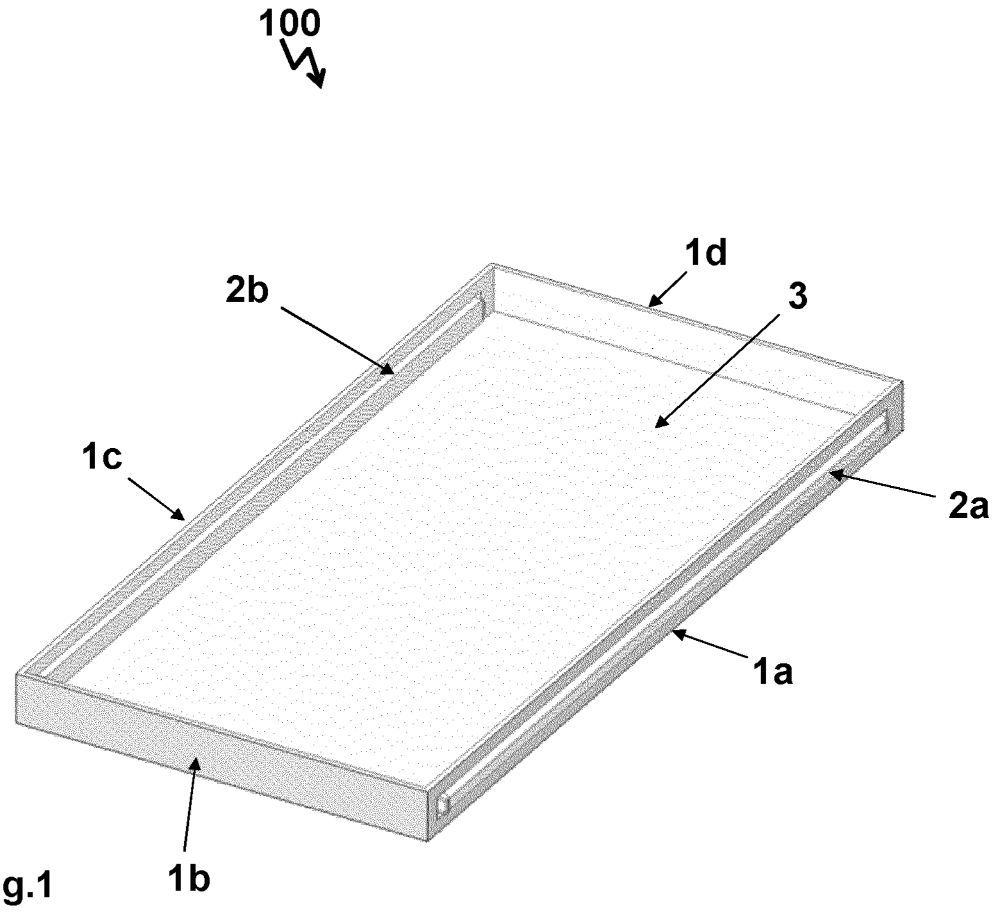

Fig.1

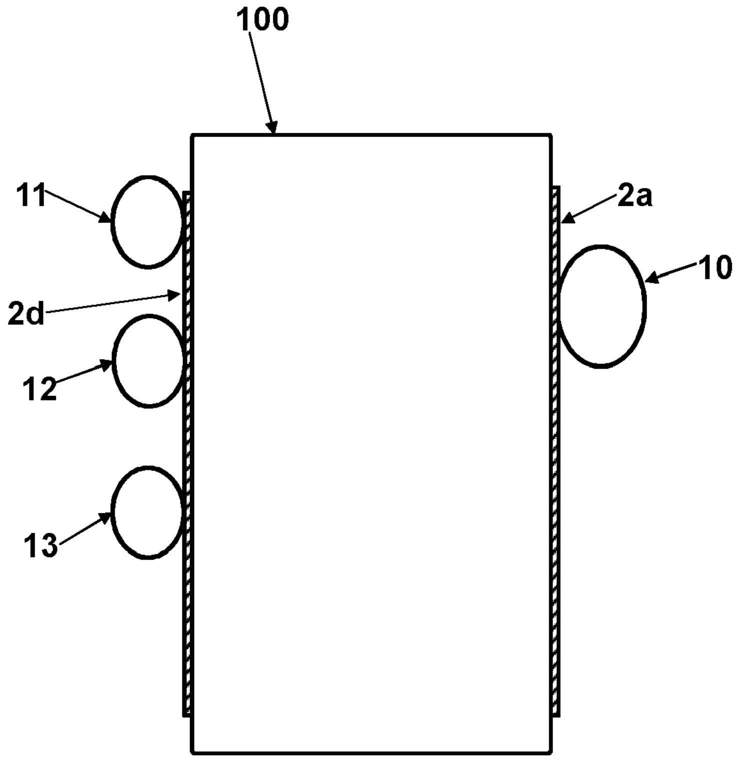

Fig.2

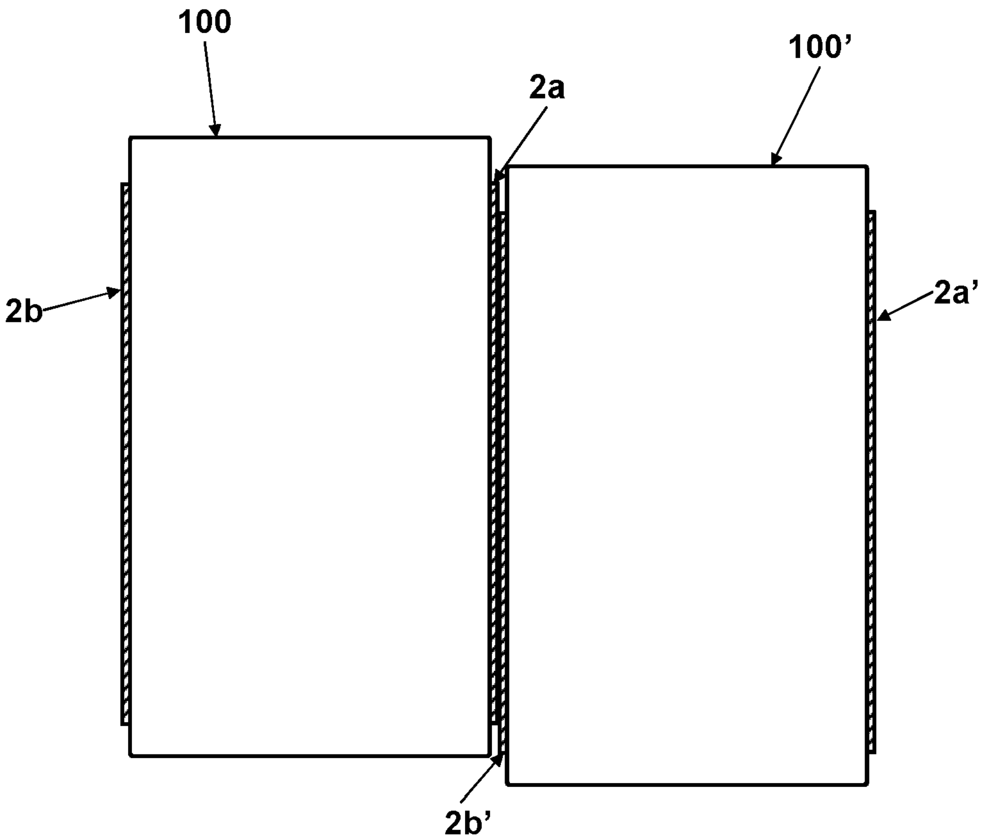

Fig.3

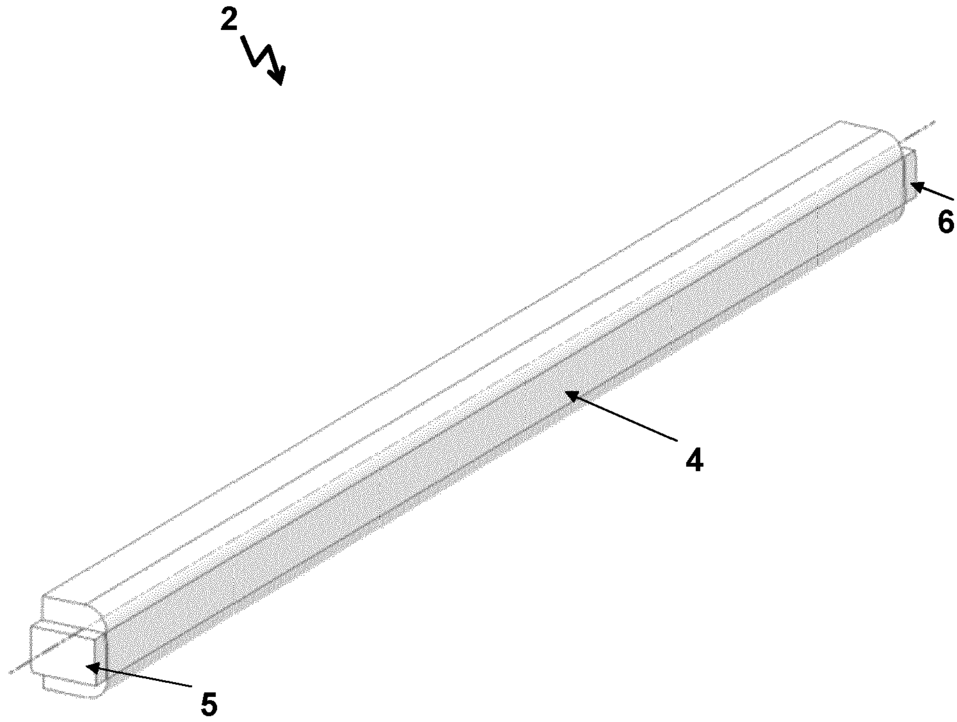

Fig.4

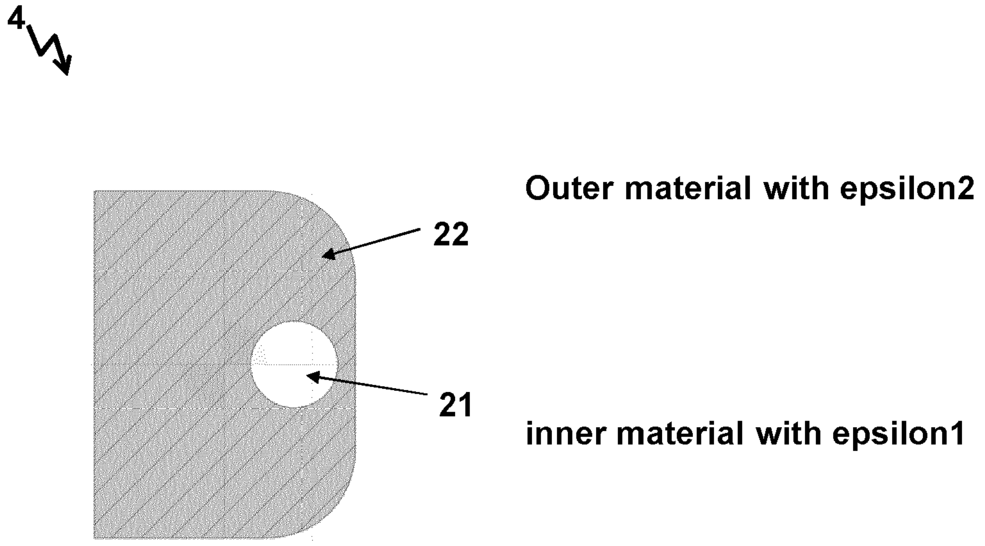
4
Outer material with epsilon2
22
21
inner material with epsilon1

Fig.5

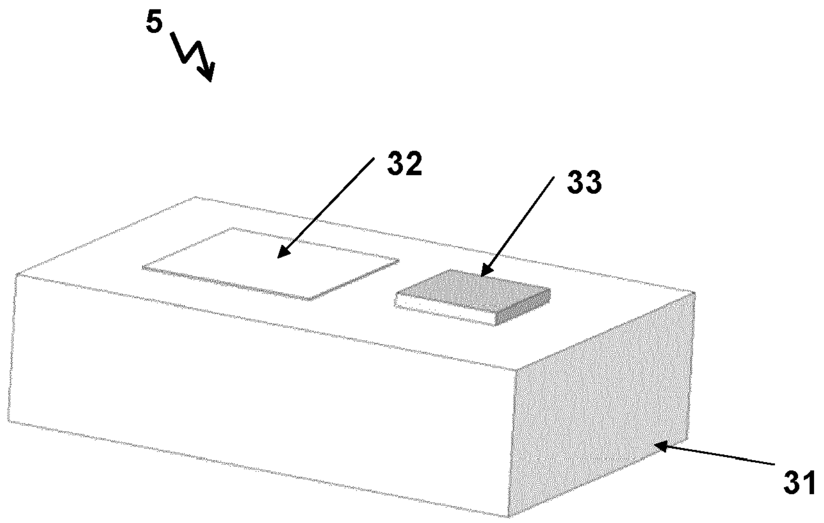

Fig.6

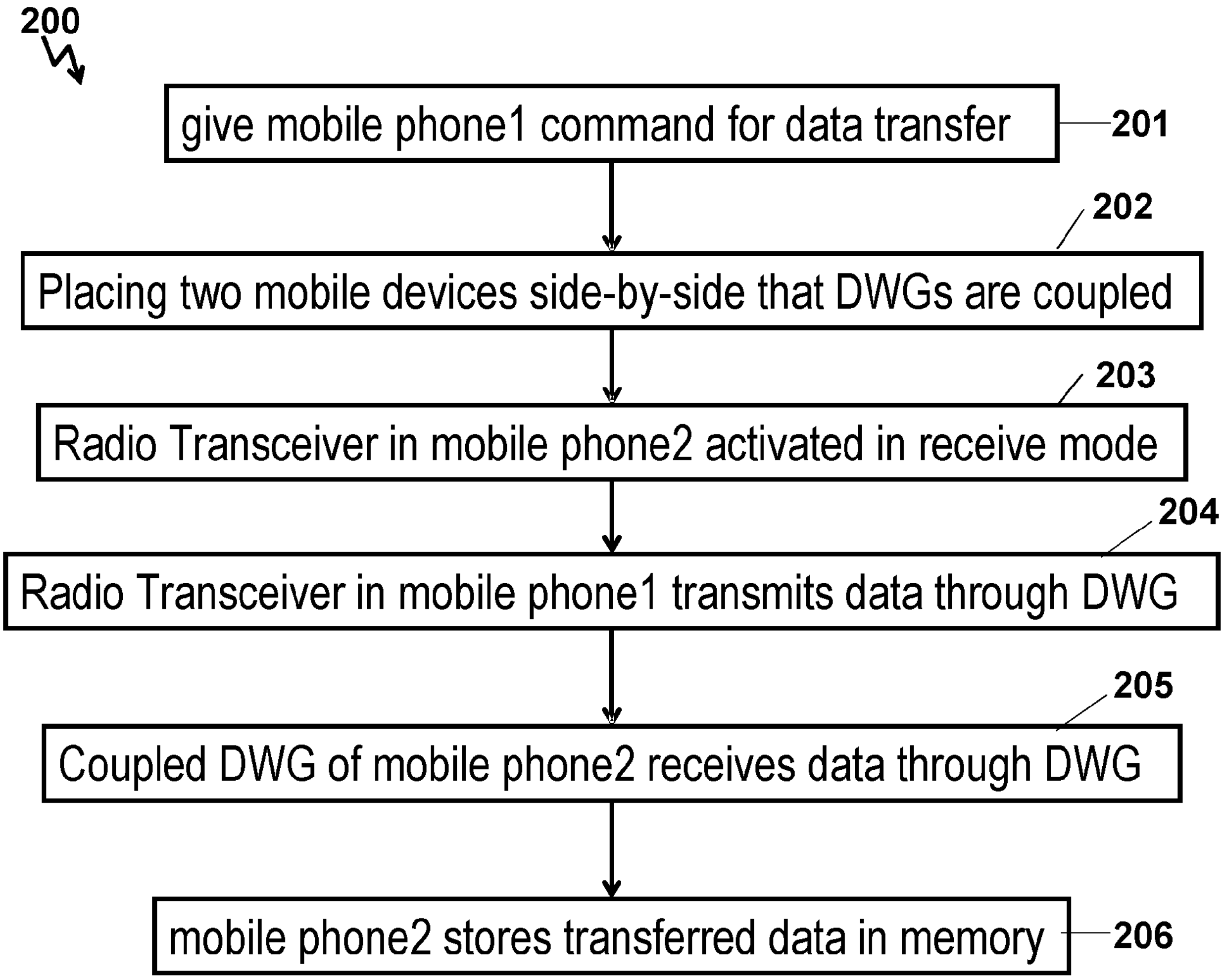
200
give mobile phone1 command for data transfer
201
202
Placing two mobile devices side-by-side that DWGs are coupled
203
Radio Transceiver in mobile phone2 activated in receive mode
204
Radio Transceiver in mobile phone1 transmits data through DWG
205
Coupled DWG of mobile phone2 receives data through DWG
mobile phone2 stores transferred data in memory
206

Fig.7

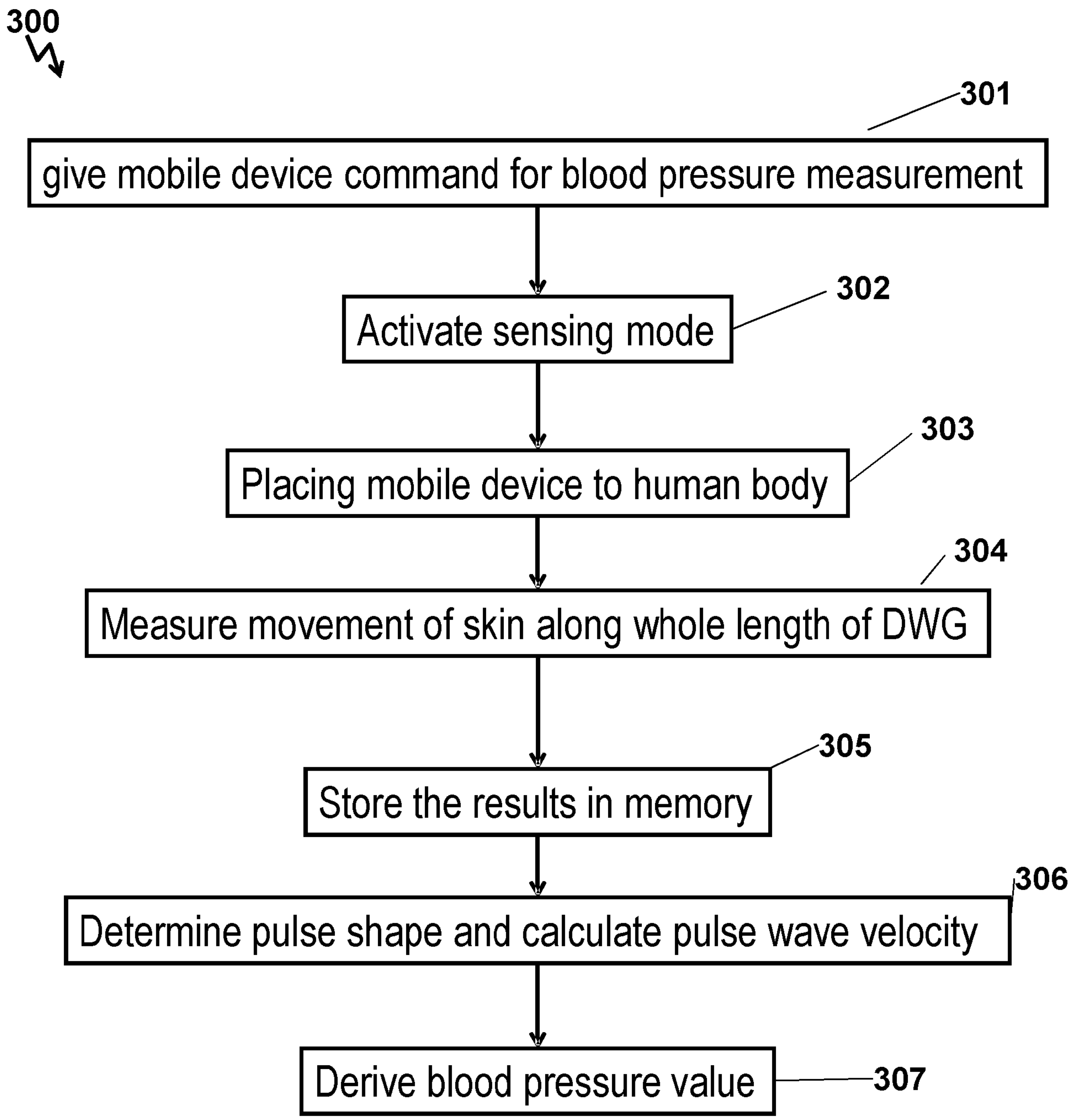
300
301
give mobile device command for blood pressure measurement
302
Activate sensing mode
303
Placing mobile device to human body
304
Measure movement of skin along whole length of DWG
305
Store the results in memory
306
Determine pulse shape and calculate pulse wave velocity
Derive blood pressure value
307

Fig.8

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EUROPEAN SEARCH REPORT

Application Number
EP 22 19 2337

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The present search report has been drawn up for all claims

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Place of search	Date of completion of the search	Examiner
The Hague	10 February 2023	Pastor Jiménez, J

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