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(54) **Portable device for measuring blood pressure and method therefor**

Tragbare Vorrichtung zum Messen des Blutdrucks und Verfahren dafür

Dispositif portable pour mesurer la pression artérielle et procédé correspondant

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**Description****BACKGROUND OF THE INVENTION**

## 5 1. Field of the Invention

**[0001]** The present invention relates generally to a portable device for measuring blood pressure and a method therefor. More particularly, the present invention relates to a portable device for measuring wrist or finger arterial pressure corresponding to brachial arterial pressure and a method therefor.

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## 2. Description of the Related Art

**[0002]** Blood pressure is one of the most useful vital signs for human health care. Clinically, blood pressure provides an index by which abnormalities of the circulatory system, including the heart and blood vessels, can be diagnosed. Blood pressure outside a normal range requires consistent care. Arterial pressure changes with cardiac pulsation. The peak pressure the arteries feel when the ventricles are contracting and pushing the blood out into the arteries is called systolic pressure. Even when the ventricles are relaxing and filling back up with blood, the elasticity of the walls of the arteries maintains some blood pressure, and thus the blood pressure does not drop to zero. This lower level of blood pressure is called diastolic pressure.

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**[0003]** Nervousness often results in a high blood pressure measurement when a person visits a clinic. Since blood pressure varies with a variety of factors, it is difficult to get an accurate blood pressure measurement at one time. Hence, a home-use electronic blood pressure monitor is necessary to enable users to constantly measure their blood pressures at their homes. The most widely used automatic electronic blood pressure monitor operates by volume oscillometry. The volume oscillometry scheme measures blood pressure based on oscillations that are generated by raising or dropping pressure to the arteries with use of a cuff. In this measuring method, the cuff pressure at which the pulse arising from cardiac pulsation has a maximum amplitude that is estimated to be a mean blood pressure. Herein, the systolic and diastolic pressures are estimated to be cuff pressures having 45 to 57% and 74 to 82% of the maximum amplitude, respectively.

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**[0004]** FIG. 1 is a graph illustrating blood pressure measurements based on oscillation pressures of a cuff. Referring to FIG. 1, the ratio of a systolic amplitude to a maximum amplitude and the ratio of a diastolic amplitude to the maximum amplitude are called characteristic ratios, which vary with individuals. It is known that the characteristic ratios are greatly affected by cuff characteristics, the characteristics of artery vessels, the shape and amplitude of arterial pressure waves, etc.

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**[0005]** At present, most blood pressure monitors measure blood pressure in an upper arm at heart level. For measurement convenience, products for measuring blood pressure in a wrist or a finger using a cuff have been developed and commercialized.

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**[0006]** Such a wrist- or finger-type blood pressure monitor is smaller than the upper arm-type monitor. Due to the small size, the wrist- or finger-type blood pressure monitor is portable and obviates the need to take off a portion of a patient's clothing for pressure measuring, thus allowing blood pressure measuring at any time. However, because a wrist or finger arterial signal is weaker than a brachial arterial signal, it basically has a low Signal-to-Noise Ratio (SNR). Therefore, the wrist- or finger-type blood pressure monitor is less accurate than the upper arm-type one.

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**[0007]** Blood pressure may differ at different artery positions due to a plurality of factors. Hence, the wrist- or finger-type blood pressure monitor may give a different blood pressure measurement from that of the upper arm-type one. As a consequence, blood pressure measurements of the wrist- or finger-type blood pressure monitor may be less reliable to users.

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**[0008]** A conventional wrist- or finger-type blood pressure monitor measures an arterial pressure by oscillometry, like the upper arm-type blood pressure monitor. If the blood pressure monitor is precise and the brachial arterial pressure is equal to the wrist- or finger arterial pressure, a pressure at the upper arm should be equal to a pressure at the wrist or finger which is leveled at the heart height.

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**[0009]** However, the brachial arterial pressure is different from the wrist or finger arterial pressure due to the characteristics of blood flow, and the differences between individuals.

**[0010]** That is, a measured wrist or finger arterial pressure of a user may be higher or lower than a measured brachial arterial pressure for the same individual.

**[0011]** FIG. 2 illustrates characteristics of blood pressure and waveform changes with respect to the positions of arteries. In FIG. 2, pulse pressure changes with respect to the distances of the arteries to an aorta are shown, as well as pulse pressure changes that vary with age. That is, the difference between systolic and diastolic pressures increases at an artery more remote from an aorta at younger ages due to the overlap of reflective waves. At older ages, the difference is zero or may increase. Even individuals of the same age may differ in the systolic-diastolic difference.

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Therefore, when a user familiar with the upper arm-type blood pressure monitor popular in clinics uses the wrist- or finger-type blood pressure monitor, for use convenience or portability, he may be confused with blood pressure measurements.

5 **SUMMARY OF THE INVENTION**

[0012] The present invention has been made to address at least the above problems and/or disadvantages, and to provide at least the advantages described below.

10 [0013] An aspect of an embodiment of the present invention provides a portable blood pressure measuring apparatus for giving a user a wrist or finger arterial pressure compensated to correspond to a brachial arterial pressure that differs in individuals, and a method therefor.

15 [0014] In accordance with an aspect of an embodiment of the present invention, there is provided a portable blood pressure measuring apparatus in which a blood pressure measurer measures a blood pressure being an arterial pressure at a wrist or a finger, a Pulse Wave Velocity (PWV) measurer measures a PWV, a controller controls compensation of the blood pressure using the PWV so that the blood pressure being an arterial pressure at a wrist or finger corresponds to a brachial blood pressure as defined in claim 1, and a display displays the compensated blood pressure.

20 [0015] In accordance with another aspect of an embodiment of the present invention, there is provided a portable blood pressure measuring method as defined in claim 6 in which a blood pressure being an arterial pressure at a wrist or a finger is measured in blood pressure measuring mode, a PWV is measured, the blood pressure is compensated using the PWV so that the blood pressure being an arterial pressure at a wrist or finger corresponds to a brachial blood pressure, and the compensated blood pressure is displayed.

**BRIEF DESCRIPTION OF THE DRAWINGS**

25 [0016] The above and other aspects, features and advantages of certain embodiments of the present invention will be more apparent from the following detailed description taken in conjunction with the accompanying drawings, in which:

- FIG. 1 is a graph illustrating blood pressure measurements based on oscillation pressures of a cuff;
- FIG. 2 illustrates characteristics of blood pressure and waveform changes with respect to the positions of arteries;
- 30 FIG. 3 illustrates measuring of a Pulse Wave Velocity (PWV) using an ElectroCardioGram (ECG) signal and a PhotoPlethysnoGraphy (PPG) signal;
- FIGs. 4A, 4B and 4C illustrate pulse wave overlap characteristics according to PWVs;
- FIG. 5 is a graph illustrating a relationship between PWV and radial and brachial blood pressures;
- FIG. 6A is a graph illustrating a relationship between PWV and radial-brachial systolic pressure difference;
- 35 FIG. 6B is a graph illustrating a relationship between PWV and radial-brachial diastolic pressure difference;
- FIG. 6C illustrate when the positions of the wrists is lower than the heart level;
- FIG. 6D illustrate when the positions of the wrists is same the heart level;
- FIG. 6E illustrate when the positions of the wrists is same the heart level;
- 40 FIG. 7 is a block diagram of a portable blood pressure measuring apparatus according to an exemplary embodiment of the present invention;
- FIG. 8 illustrates a portable blood pressure measuring apparatus according to an exemplary embodiment of the present invention;
- FIG. 9 illustrates a portable blood pressure measuring apparatus according to another exemplary embodiment of the present invention;
- 45 FIG. 10 is a flowchart illustrating an operation for measuring blood pressure in a portable blood pressure measuring apparatus according to an exemplary embodiment of the present invention; and
- FIGs. 11A and 11B are graphs illustrating blood pressures measured by a portable blood pressure measuring apparatus according to an exemplary embodiment of the present invention.

50 **DETAILED DESCRIPTION OF EMBODIMENTS OF THE INVENTION**

[0017] The matters defined in the description such as a detailed construction and elements are provided to assist in a comprehensive understanding of the embodiments of the invention. Accordingly, those of ordinary skill in the art will recognize that various changes and modifications of the embodiments described herein can be made without departing from the scope and spirit of the invention. Also, descriptions of well-known functions and constructions are omitted for clarity and conciseness. Throughout the drawings, the same drawing reference numerals will be understood to refer to the same elements, features and structures.

55 [0018] To calculate the difference between brachial blood pressure and radial blood pressure, information by which

to measure or estimate an individual deviation is necessary in a conventional blood pressure measuring method. The information may be the velocity of pulse waves from which blood pressure is measured. Accordingly, Pulse Wave Velocity (PWV) is used to compensate for an individual radial-brachial pressure difference in accordance with the present invention.

5 **[0019]** FIG. 3 illustrates measuring of a PWV using an ElectroCardioGram (ECG) signal and a PhotoPlethysnoGraphy (PPG) signal. Referring to FIG. 3, the time difference between an R-peak of the ECG signal and start of a PPG signal measured by an optical sensor in a portable blood pressure measuring apparatus carried around a wrist or a finger, namely a Pulse Transit Time (PTT) is the time taken for the PPG signal to reach a measurement spot as the ventricles are contracted. A PWV is calculated by dividing the distance between the heart and the measurement spot of the PPG  
10 signal by the PTT. The PWV is widely used as an arterial stiffness index.

**[0020]** FIGs. 4A, 4B and 4C illustrate pulse wave overlap characteristics according to PWVs. A PPG signal generated from ventricular contraction causes a reflective wave at an aortic bifurcation or an aortic termination. As illustrated in FIG. 4A, the magnitude and shape of a PPG signal at a certain spot on an artery are determined by the overlap between the original PPG signal and a reflective wave.

15 **[0021]** Referring to FIG. 4B, if the PWV is low, the overlap between the reflective wave and the PPG signal does not increase the maximum pressure of the PPG signal. On the other hand, when the PWV is high, as illustrated in FIG. 4C, if the overlap between the reflective wave and the PPG signal increases the maximum pressure of the overlapped wave, that is, the systolic pressure is above the maximum pressure of the original PPG signal, the increase of the PWV also increases the systolic pressure due to the overlap.

20 **[0022]** The overlap of the PPG signal also depends on the distance from a spot where the reflective wave is generated, as well as the PWV.

**[0023]** If a PPG signal measured at a wrist or a finger near the aortic termination where a reflective wave is created is different from a PPG signal measured at the brachial aorta relatively far from the aortic termination, in terms of magnitude and shape, this difference is caused by a difference in overlap time, as described above.

25 **[0024]** When the PWV is low, for example, when a wave having the shape illustrated in FIG. 4C is formed at the wrist aorta and a wave having the shape illustrated in FIG. 4B is formed at the brachial aorta, the systolic pressure changes as much as the difference between the maximum pressures illustrated in FIGs. 4B and 4C.

**[0025]** When the PWV increases, the maximum pressure of the wrist or finger aorta increases due to wave overlap. As a consequence, the maximum pressure difference between the wrist or finger aorta and the brachial aorta increases.

30 **[0026]** If arteriosclerosis causes an extremely high PWV, the waves of the wrist or finger and brachial aortas have the shape illustrated in FIG. 4C. In this case, the maximum pressure difference between the wrist or finger aorta and the brachial aorta may drop.

**[0027]** In general, the difference between the radial or finger artery pressure and the brachial pressure measured at the same height (i.e. the height measured from the heart level) tends to increase as the PWV is higher.

35 **[0028]** FIG. 5 is a graph illustrating a relationship between PWVs and radial and brachial blood pressures. The graph shows results of a test that was performed to verify the trend that the difference between the radial pressure and the brachial pressure increases with the PWV

**[0029]** Blood pressures of six persons were measured at heart level using a cuff-based upper arm blood pressure monitor (A&D, UA-767) and a cuff-based wrist blood pressure monitor (Citizen, CH-656C). For each person at the same  
40 position, a PWV is measured from the ECG signals of both hands and a PPG signal of a finger measured by a transmissive optical sensor. The PWV and the mean difference between the radial pressure and the brachial pressure were plotted as a graph. As expected, the graph indicates that the difference between the radial pressure and the brachial pressure increases with the PWV.

**[0030]** To find out whether the characteristics illustrated in FIG. 5 also apply to a wider range of PWVs and a wider range of blood pressures, as illustrated in Fig. 6C, 6D and 6E the positions of the wrists of the six persons were changed with respect to the heart level, thereby causing an about -30 to 40mm Hg-difference between the radial pressure and the brachial pressure. In the case illustrated in FIG. 6, it is revealed that both the systolic and diastolic pressure differences between the radial pressure and the brachial pressure have a correlation coefficient of about 0.9.

**[0031]** The operation of the portable blood pressure measuring apparatus based on the relationship between the PWV and the radial-brachial difference is described in detail with reference to FIGs. 7 to 10.

**[0032]** FIG. 7 is a block diagram of a portable blood pressure measuring apparatus according to a preferred embodiment of the present invention, FIG. 8 illustrates a portable blood pressure measuring apparatus according to embodiment of the present invention, FIG. 9 illustrates a portable blood pressure measuring apparatus according to another preferred embodiment of the present invention, and FIG. 10 is a flowchart illustrating an operation for measuring blood pressure  
55 in a portable blood pressure measuring apparatus according to an preferred embodiment of the present invention.

**[0033]** Referring to FIG. 7, a pressure measurer 720 measures a wrist or finger and provides the pressure measurement to a controller 710. Also provided are display 750, memory 740 and keypad 760.

**[0034]** A PWV measurer 730 measures a PWV, including an ECG electrode portion 731 and an optical sensor 732.

[0035] The ECG electrode portion 731 includes at least two electrodes. It is assumed that the ECG electrode portion 731 includes three electrodes in accordance with the exemplary embodiment of the present invention. Two of the three electrodes are provided inside a cuff of the portable blood pressure measuring apparatus and the other electrode is provided outside the cuff. Alternatively, one of the three electrodes is inside the cuff, while the other two electrodes are positioned outside the cuff.

[0036] The optical sensor 732 includes a light source and a light receiving device. The optical sensor 732 may reside in the cuff or in an additional device attached to a finger.

[0037] The structure of the PWV measurer 730 will be described in detail with reference to FIGs. 8 and 9. FIG. 8 illustrates a wrist-type blood pressure measuring apparatus. Three electrodes 731 a, 731b and 731c for measuring an ECG signal are added to a conventional blood pressure monitor cuff 770. An optical sensor 732 for measuring a PPG signal is provided inside a cuff 770 that contacts a wrist aorta portion or is provided in an additional device 800 that wraps around a finger.

[0038] As illustrated in FIG. 8, regarding ECG electrodes, two ECG electrodes (e.g. a (-) electrode 731a and a GND electrode 731b) are provided at a portion that contacts with an arm around which the cuff 770 is wrapped, and one ECG electrode (e.g. a positive (+) electrode 731c) is provided on a display 750 or outside the cuff 770. Alternatively, the electrode 731c may be positioned inside the cuff 770 and the two electrodes 731a and 731b may be positioned outside the cuff 770.

[0039] When blood pressure is measured, the ECG electrodes within the cuff 770 are brought into contact with the arm around which the cuff 770 is wrapped. Therefore, an ECG is measured by contacting a finger from the hand of the arm without the cuff 770.

[0040] As illustrated in FIG. 8, pulse waves by which to measure the PWV may be measured by adding a transmissive optical sensor 732a and 732b to the additional device 800 installed to the finger or a reflective optical sensor (a light source 732c and a light receiving device 732d) inside the cuff 770. Especially when a PPG signal is measured at the wrist aorta, it is preferable to dispose the light source 732c and the light receiving device 732d such that the aorta is positioned between the light source 732c and the light receiving devices 732d.

[0041] FIG. 9 illustrates a finger-type blood pressure measuring apparatus. Like the wrist-type blood pressure measuring apparatus, the finger-type blood pressure measuring apparatus preferably additionally has ECG electrodes 730 inside and outside the cuff 770 in order to measure the PWV. Since the finger aorta is small, oscillation may be measured by use of optical sensors 732a and 732b instead of pressure oscillation of the cuff 770. In this case, the optical sensors 732a and 732b are added inside the cuff 770 to apply the oscillometry method, compared to the wrist-type blood pressure measuring apparatus. The PWV may be measured using the optical sensors 732a and 732b.

[0042] However, since the PWV changes when pressure is applied to arterial vessels by pressing the cuff 770, it is preferred that a transmissive or reflective optical sensor is additionally provided in an additional device 800 attached to the tip of the finger, besides the optical sensor within the cuff.

[0043] The controller 710 provides overall control to the portable blood pressure measuring apparatus. Upon receipt of a wrist or finger pressure value measured by the pressure measurer 720, the controller 710 controls compensation of the received wrist or finger pressure value using the PWV received from the PWV measurer 730 by an equation for compensating the wrist or finger pressure to correspond to a brachial pressure.

[0044] The controller 720 controls the compensated wrist or finger pressure to be displayed on the display 750.

[0045] The memory 740 stores the compensation equation which has been selected from among the following compensation equations:

$$P_{\text{brachial}} = a + b \times P_{\text{wrist or finger}} + c \times \text{PWV} \dots\dots\dots (1)$$

$$P_{\text{brachial}} = a + b \times P_{\text{wrist or finger}} + c \times \text{PWV} + d \times \text{PWV}^2 \dots\dots\dots (2)$$

$$P_{\text{brachial}} = a + b \times P_{\text{wrist or finger}} + c \times \text{PWV} + d \times \text{PWV}^2 + e \times \text{PWV}^3 \dots\dots (3),$$

where  $P_{\text{brachial}}$  is a brachial blood pressure  $P_{\text{wrist or finger}}$  is a blood pressure measured at the wrist or finger, PWV is a PWV, and a, b, c, d and e are empirical constants for compensating the wrist or finger pressure value.

[0046] The compensation equation can also be empirically selected by a developer of the portable blood pressure measuring apparatus. The developer determines the correlation coefficients between wrist or finger and brachial pressure difference and the PWV for both systolic and diastolic pressures, selects an equation that approximates the wrist or

finger pressure to the brachial pressure from among the equations as described above, and stores the equation in the memory 740. Alternatively, the developer derives more than the above compensation equations by performing testing based on an equation  $P_{\text{brachial}} = f(P_{\text{wrist or finger}}, \text{PWV})$ , pursuant to the relationship between PWV and wrist or finger-brachial pressure difference illustrated in FIG. 6.

5 [0047] In accordance with an embodiment of the present invention, the memory 740 stores all of equations 1 through 3 so that only a user-selected equation is used in pressure measuring mode, and the memory 740 preferably also stores the compensated radial pressure.

[0048] The display 750 displays the wrist or finger pressure compensated to correspond to the brachial pressure in the pressure measuring mode. The keypad 760 includes function keys by which functions of the portable blood pressure measuring apparatus are set.

10 [0049] A blood pressure measuring operation of the portable blood pressure measuring apparatus illustrated in FIGs. 7, 8 and 9 is described in detail with reference to FIG. 10.

[0050] FIG. 10 is a flowchart illustrating an operation for measuring blood pressure in a portable blood pressure measuring apparatus according to a preferred embodiment of the present invention.

15 [0051] Referring to FIG. 10, upon selection of pressure measuring mode by key input of the keypad 760, the controller 740 senses the pressure measuring mode and transitions the portable blood pressure measuring apparatus to a pressure measuring mode in step 1001.

[0052] The pressure measurer 720 measures a wrist or finger pressure by the oscillation of the cuff and transmits the wrist or finger pressure to the controller 740 in the pressure measuring mode in step 1002.

20 [0053] In step 1003, the PWV measurer 730 measures a PWV through the ECG electrode portion 731 and the optical sensor 732 and provides the PWV to the controller 740.

[0054] Upon receipt of the wrist or finger pressure and the PWV, the controller 740 compensates the wrist or finger pressure to correspond to a brachial pressure utilizing the compensation equation stored in the memory 740, in step 1004.

[0055] In step 1005, the controller 740 displays the compensated wrist or finger pressure on the display 750.

25 [0056] FIGs. 11A and 11B are graphs illustrating blood pressures measured by a portable blood pressure measuring apparatus according to a preferred embodiment of the present invention. In FIG. 11, in the case of an about -30 to 40mm Hg difference between the radial pressure and the brachial pressure as illustrated in FIG. 6, the pressure difference is decreased by the procedure of FIG. 10. The compensation equation used herein is equation 1.

[0057] As is apparent from the above description, the portable blood pressure measuring apparatus and method of the present invention effectively eliminate the difference between a radial pressure and a brachial pressure for individuals using a PWV. Therefore, the radial pressure is compensated to correspond to the brachial pressure, for the user. Since consistency is secured between an upper arm blood pressure monitor used in a clinic and a wrist-type or finger-type blood pressure monitor, instant blood pressure measurement and management is obtained.

30 [0058] Embodiments of the present invention can also be embodied as computer-readable codes on a computer-readable recording medium. The computer-readable recording medium includes data storage devices that store data for subsequent use by a computer system. Examples of the computer-readable recording medium include, but are not limited to, Read-Only Memory (ROM), Random-Access Memory (RAM), CD-ROMs, magnetic tapes, floppy disks, optical data storage devices, and carrier waves (such as data transmission through the Internet via wired or wireless transmission paths). The computer-readable recording medium can also be distributed over network-coupled computer systems so that the computer-readable code is stored and executed in a distributed fashion. Also, function programs, codes, and code segments for accomplishing the present invention can be easily construed as within the scope of the invention by programmers skilled in the art to which the present invention pertains.

## 45 Claims

1. A portable blood pressure measuring apparatus comprising:

50 a blood pressure measurer (720) for measuring a radial blood pressure, wherein the radial blood pressure is an arterial pressure measured at a wrist or a finger;

a Pulse Wave Velocity (PWV) measurer (730) for measuring a PWV;

a controller (710) for controlling compensation of the radial blood pressure using the measured PWV so that the radial blood pressure corresponds to a brachial blood pressure; and

a display (750) for displaying the compensated radial blood pressure;

55 wherein the controller (710) controls the compensation of the radial blood pressure using one of the following equations,

$$\langle \text{equation 1} \rangle : P_{\text{brachial}} = a + bP_{\text{radial}} + cP_{\text{PWV}}$$

$$\langle \text{equation 2} \rangle : P_{\text{brachial}} = a + bP_{\text{radial}} + cP_{\text{PWV}} + dP_{\text{PWV}}^2$$

$$\langle \text{equation 3} \rangle : P_{\text{brachial}} = a + bP_{\text{radial}} + cP_{\text{PWV}} + dP_{\text{PWV}}^2 + eP_{\text{PWV}}^3$$

where  $P_{\text{brachial}}$  is a brachial blood pressure measurement,  $P_{\text{radial}}$  is a radial blood pressure measurement, PWV is a PWV, and a, b, c, d and e are empirical constants for compensating the radial blood pressure measurement.

2. The portable blood pressure measuring apparatus of claim 1, wherein the PWV measurer (730) includes an ElectroCardioGram (ECG) electrode portion (731) for measuring an ECG signal and an optical sensor (732) for measuring a PhotoPlethysnoGraphy signal.
3. The portable blood pressure measuring apparatus of claim 2, wherein the ECG electrode portion (731) includes at least two electrodes, at least one of the electrodes positioned inside a cuff (770) of the portable blood pressure measuring apparatus and at least another one of the electrodes positioned outside the cuff (770).
4. The portable blood pressure measuring apparatus of claim 2, wherein the optical sensor (732) includes a light source (732c) and a light receiving device (732d) and is provided inside a cuff (770) of the portable blood pressure measuring apparatus or at an additional device attached to the finger.
5. The portable blood pressure measuring apparatus of claim 1, further comprising a memory (740) for pre-storing the selected one of  $\langle \text{equation 1} \rangle$ ,  $\langle \text{equation 2} \rangle$ , and  $\langle \text{equation 3} \rangle$ .
6. A portable blood pressure measuring method comprising:

measuring a radial blood pressure being an arterial pressure at a wrist or a finger in blood pressure measuring mode;  
 measuring a Pulse Wave Velocity (PWV);  
 compensating the radial blood pressure using the PWV so that the radial blood pressure corresponds to a brachial blood pressure; and  
 displaying the compensated radial blood pressure;  
 wherein the compensation comprises compensating the radial blood pressure using one of the following equations,

$$\langle \text{equation 1} \rangle : P_{\text{brachial}} = a + bP_{\text{radial}} + cP_{\text{PWV}}$$

$$\langle \text{equation 2} \rangle : P_{\text{brachial}} = a + bP_{\text{radial}} + cP_{\text{PWV}} + dP_{\text{PWV}}^2$$

$$\langle \text{equation 3} \rangle : P_{\text{brachial}} = a + bP_{\text{radial}} + cP_{\text{PWV}} + dP_{\text{PWV}}^2 + eP_{\text{PWV}}^3$$

where  $P_{\text{brachial}}$  is a brachial blood pressure measurement,  $P_{\text{radial}}$  is a radial blood pressure measurement, PWV is a PWV, and a, b, c, d and e are empirical constants for compensating the radial blood pressure measurement.

7. The portable blood pressure measuring method of claim 6, wherein the PWV measuring comprises measuring the PWV using an ElectroCardioGram (ECG) signal and a PhotoPlethysnoGraphy signal.
8. The portable blood pressure measuring method of claim 6, wherein the selected one of  $\langle \text{equation 1} \rangle$ ,  $\langle \text{equation 2} \rangle$ , and  $\langle \text{equation 3} \rangle$  is pre-stored.

Patentansprüche

1. Tragbares Blutdruckmessgerät, umfassend:

5 einen Blutdruckmesser (720) zum Messen eines Radialblutdrucks, wobei der Radialblutdruck ein an einem Handgelenk bzw. einer Handwurzel oder einem Finger gemessener Arterialdruck ist;  
 einen PWV-Messer (Pulse Wave Velocity PWV, Pulswellengeschwindigkeit) (730) zum Messen einer PWV;  
 eine Steuerung (710) zum Steuern eines Ausgleiches des Radialblutdrucks unter Verwendung der gemessenen  
 10 PWV derart, dass der Radialblutdruck einem Brachialblutdruck entspricht; und  
 eine Anzeige (750) zum Anzeigen des ausgeglichenen Radialblutdrucks;  
 wobei die Steuerung (710) den Ausgleich des Radialblutdrucks unter Verwendung von einer der nachfolgenden Gleichungen steuert:

15 <Gleichung 1> :  $P_{\text{brachial}} = a + b \times P_{\text{radial}} + c \times \text{PWV}$

20 <Gleichung 2> :  $P_{\text{brachial}} = a + b \times P_{\text{radial}} + c \times \text{PWV} + d \times \text{PWV}^2$

25 <Gleichung 3> :  $P_{\text{brachial}} = a + b \times P_{\text{radial}} + c \times \text{PWV} + d \times \text{PWV}^2 + e \times \text{PWV}^3$

wobei  $P_{\text{brachial}}$  eine Brachialblutdruckmessung ist,  $P_{\text{radial}}$  eine Radialblutdruckmessung ist, PWV eine PWV ist und a, b, c, d und e empirische Konstanten zum Ausgleichen der Radialblutdruckmessung sind.

30 2. Tragbares Blutdruckmessgerät nach Anspruch 1, wobei der PWV-Messer (730) einen ElectroCardioGram-Elektrodenabschnitt (ElectroCardioGram ECG, Elektrokardiogramm) (731) zum Messen eines ECG-Signals und einen optischen Sensor (732) zum Messen eines PhotoPlethysnoGraphy-Signals beinhaltet.

35 3. Tragbares Blutdruckmessgerät nach Anspruch 2, wobei der ECG-Elektrodenabschnitt (731) wenigstens zwei Elektroden beinhaltet, wobei wenigstens eine der Elektroden innerhalb einer Manschette (770) des tragbaren Blutdruckmessgerätes positioniert ist und wenigstens eine weitere der Elektroden außerhalb der Manschette (770) positioniert ist.

40 4. Tragbares Blutdruckmessgerät nach Anspruch 2, wobei der optische Sensor (732) eine Lichtquelle (732c) und eine Lichtempfangsvorrichtung (732d) beinhaltet und innerhalb einer Manschette (770) des tragbaren Blutdruckmessgerätes oder an einer an dem Finger angebrachten zusätzlichen Vorrichtung vorgesehen ist.

5. Tragbares Blutdruckmessgerät nach Anspruch 1, des Weiteren umfassend einen Speicher (740) zum Vorabspeichern der ausgewählten von <Gleichung 1 >, <Gleichung 2> und <Gleichung 3>.

45 6. Tragbares Blutdruckmessverfahren, umfassend:

Messen eines Radialblutdrucks, der ein Arterialdruck an einem Handgelenk bzw. einer Handwurzel oder einem Finger im Blutdruckmessmodus ist;  
 Messen einer Pulswellengeschwindigkeit (Pulse Wave Velocity PWV);  
 50 Ausgleichen des Radialblutdrucks unter Verwendung der PWV derart, dass der Radialblutdruck einem Brachialblutdruck entspricht; und  
 Anzeigen des ausgeglichenen Radialblutdrucks;  
 wobei der Ausgleich ein Ausgleichen des Radialblutdrucks unter Verwendung von einer der nachfolgenden Gleichungen beinhaltet:

55

<Gleichung 1> :  $P_{\text{brachial}} = a + b \times P_{\text{radial}} + c \times \text{PWV}$

5

<Gleichung 2> :  $P_{\text{brachial}} = a + b \times P_{\text{radial}} + c \times \text{PWV} + d \times \text{PWV}^2$

10

<Gleichung 3> :  $P_{\text{brachial}} = a + b \times P_{\text{radial}} + c \times \text{PWV} + d \times \text{PWV}^2 + e \times \text{PWV}^3$

wobei  $P_{\text{brachial}}$  eine Brachialblutdruckmessung ist,  $P_{\text{radial}}$  eine Radialblutdruckmessung ist, PWV eine PWV ist und a, b, c, d und e empirische Konstanten zum Ausgleichen der Radialblutdruckmessung sind.

- 15 7. Tragbares Blutdruckmessverfahren nach Anspruch 6, wobei das Messen der PWV ein Messen der PWV unter Verwendung eines ElectroCardioGram-Signals (ElectroCardioGram ECG, Elektrokardiogramm) und eines Photo-PlethysnoGraphy-Signals umfasst.
- 20 8. Tragbares Blutdruckmessverfahren nach Anspruch 6, wobei die ausgewählte von <Gleichung 1 >, <Gleichung 2> und <Gleichung 3> vorab gespeichert wird.

### Revendications

- 25 1. Appareil portable de mesure de la pression sanguine comprenant :
- un dispositif de mesure de pression sanguine (720) pour mesurer une pression sanguine radiale, dans lequel la pression sanguine radiale est une pression artérielle mesurée au poignet ou à un doigt ;
  - un dispositif de mesure (730) de la vitesse du pouls (PWV) pour mesurer la PWV ;
  - 30 - un dispositif de commande (710) pour commander une compensation de la pression sanguine radiale en utilisant la PWV mesurée de sorte que la pression sanguine radiale corresponde à une pression sanguine brachiale ; et
  - un afficheur (750) pour afficher la pression sanguine radiale compensée ;
  - dans lequel le dispositif de commande (710) commande la compensation de la pression sanguine radiale en utilisant une des équations suivantes :

35

<équation 1> :  $P_{\text{brachial}} = a + b \times P_{\text{radial}} + c \times \text{PWV}$

40

<équation 2> :  $P_{\text{brachial}} = a + b \times P_{\text{radial}} + c \times \text{PWV} + d \times \text{PWV}^2$

45

<équation 3> :  $P_{\text{brachial}} = a + b \times P_{\text{radial}} + c \times \text{PWV} + d \times \text{PWV}^2 + e \times \text{PWV}^3$

- dans lesquelles  $P_{\text{brachial}}$  est une mesure de la pression sanguine brachiale,  $P_{\text{radial}}$  est une mesure de la pression sanguine radiale, PWV est une PWV et a, b, c, d et e sont des constantes empiriques pour compenser la mesure de la pression sanguine radiale.

50

2. Appareil portable de mesure de la pression sanguine selon la revendication 1, dans lequel le dispositif de mesure de PWV (730) comprend une partie d'électrode (731) d'électrocardiogramme (ECG) pour mesurer un signal ECG et un capteur optique (732) pour mesurer un signal de photopléthysmographie.
- 55 3. Appareil portable de mesure de la pression sanguine selon la revendication 2, dans lequel la partie d'électrode ECG (731) comprend au moins deux électrodes, au moins une des électrodes positionnée à l'intérieur d'un brassard (770) de l'appareil portable de mesure de la pression sanguine et au moins une autre des électrodes positionnée

à l'extérieur du brassard (770).

4. Appareil portable de mesure de la pression sanguine selon la revendication 2, dans lequel le capteur optique (732) comprend une source de lumière (732c) et un dispositif de réception de lumière (732d) et est disposé à l'intérieur d'un brassard (770) de l'appareil portable de mesure de la pression sanguine ou au niveau d'un dispositif supplémentaire attaché au doigt.

5. Appareil portable de mesure de la pression sanguine selon la revendication 1, comprenant en outre une mémoire (740) pour pré-stocker l'équation sélectionnée parmi <équation 1>, <équation 2> et <équation 3>.

6. Procédé portable de mesure de la pression sanguine, comprenant les étapes consistant à :

- mesurer une pression sanguine radiale qui est une pression artérielle au poignet ou à un doigt en mode de mesure de pression sanguine ;
- mesurer une vitesse du pouls (PWV) ;
- compenser la pression sanguine radiale en utilisant la PWV mesurée de sorte que la pression sanguine radiale corresponde à une pression sanguine brachiale ; et
- afficher la pression sanguine radiale compensée ;
- pour lequel la compensation comprend de compenser la pression sanguine radiale en utilisant une des équations suivantes :

$$\text{<équation 1> : } P_{\text{brachial}} = a + b \times P_{\text{radial}} + c \times \text{PWV}$$

$$\text{<équation 2> : } P_{\text{brachial}} = a + b \times P_{\text{radial}} + c \times \text{PWV} + d \times \text{PWV}^2$$

$$\text{<équation 3> : } P_{\text{brachial}} = a + b \times P_{\text{radial}} + c \times \text{PWV} + d \times \text{PWV}^2 + e \times \text{PWV}^3$$

- dans lesquelles  $P_{\text{brachial}}$  est une mesure de la pression sanguine brachiale,  $P_{\text{radial}}$  est une mesure de la pression sanguine radiale, PWV est une PWV et a, b, c, d et e sont des constantes empiriques pour compenser la mesure de la pression sanguine radiale.

7. Procédé portable de mesure de la pression sanguine selon la revendication 6, pour lequel la mesure de la PWV comprend de mesurer la PWV en utilisant un signal d'électrocardiogramme (ECG) et un signal de photopléthysmographie.

8. Procédé portable de mesure de la pression sanguine selon la revendication 6, pour lequel l'équation sélectionnée parmi <équation 1>, <équation 2> et <équation 3> est pré-stockée.

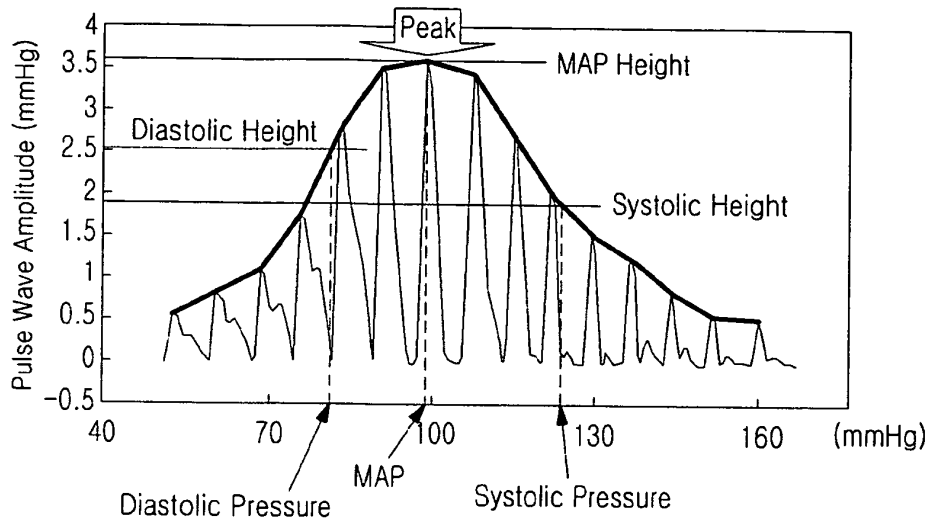


FIG.1

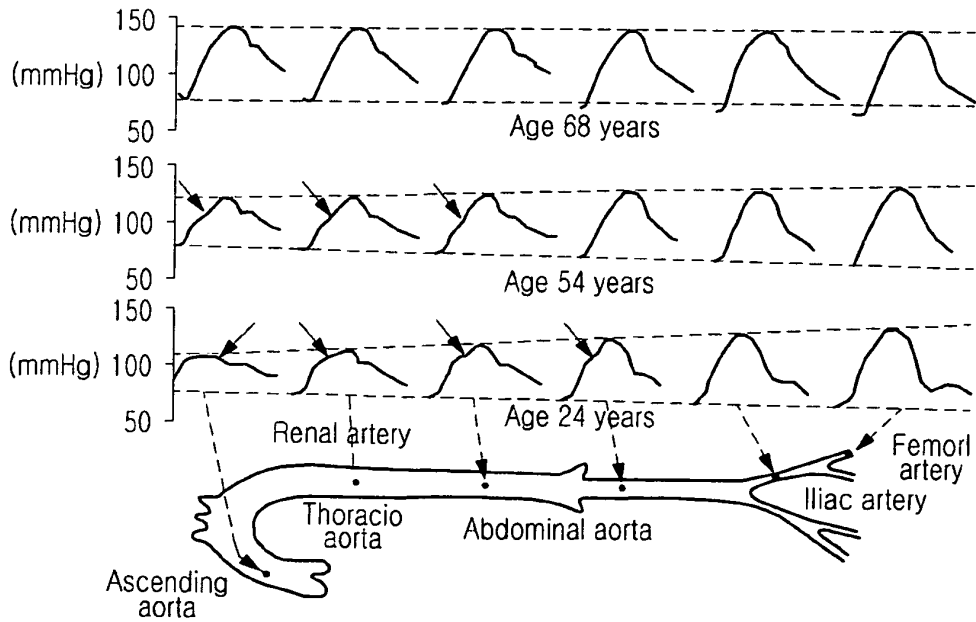


FIG.2

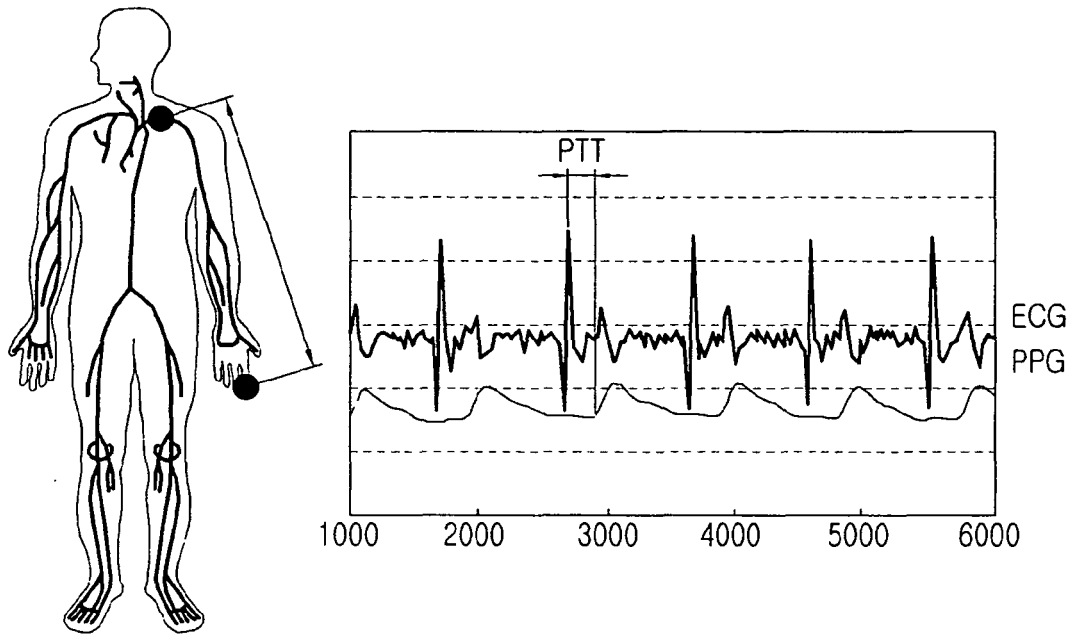


FIG.3

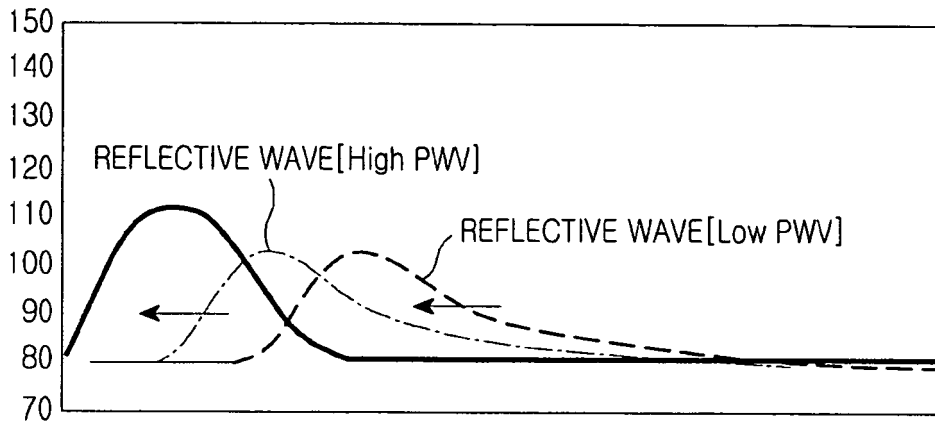


FIG.4A

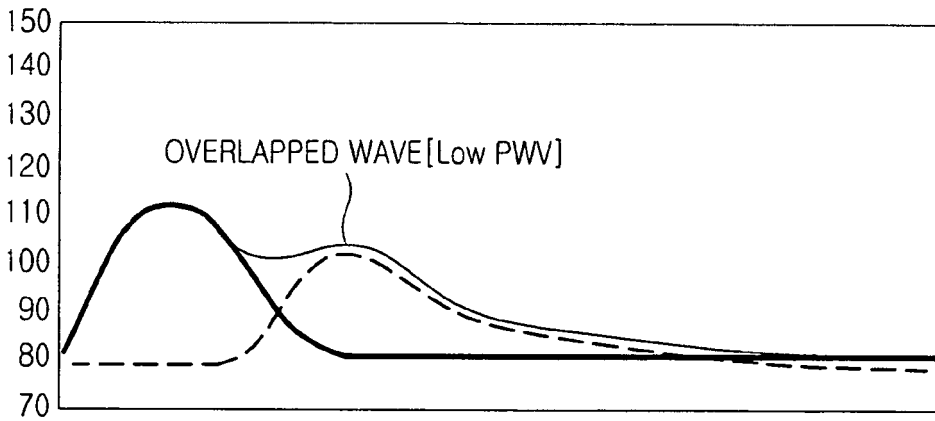


FIG.4B

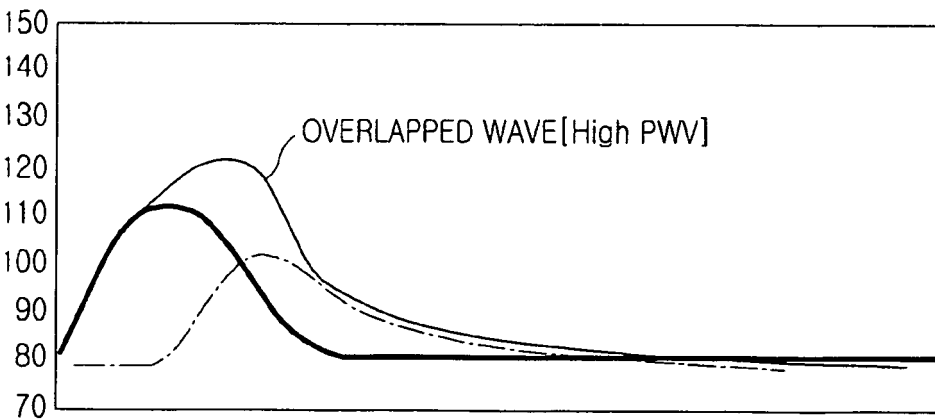


FIG.4C

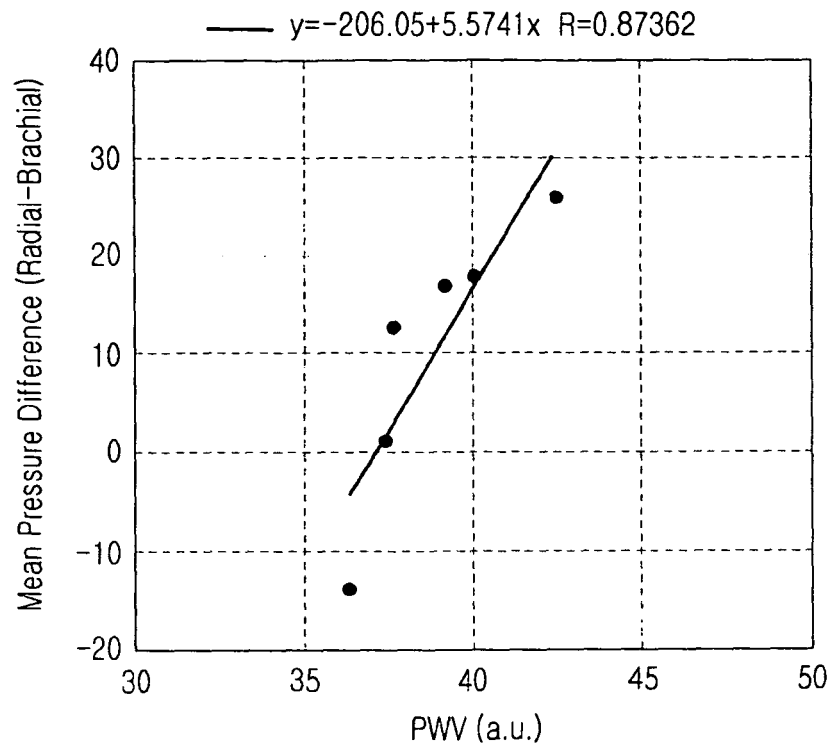


FIG.5

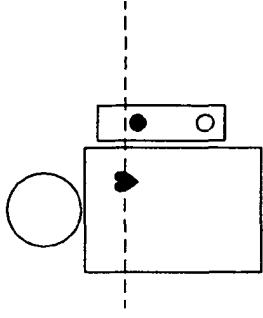


FIG.6C

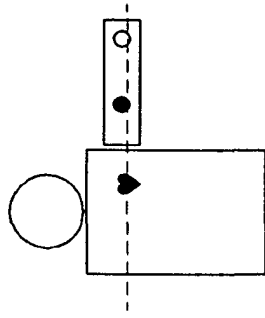


FIG.6D

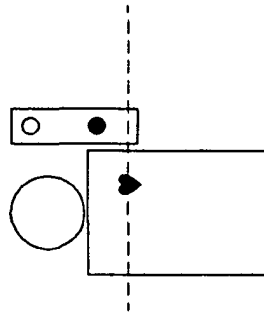


FIG.6E

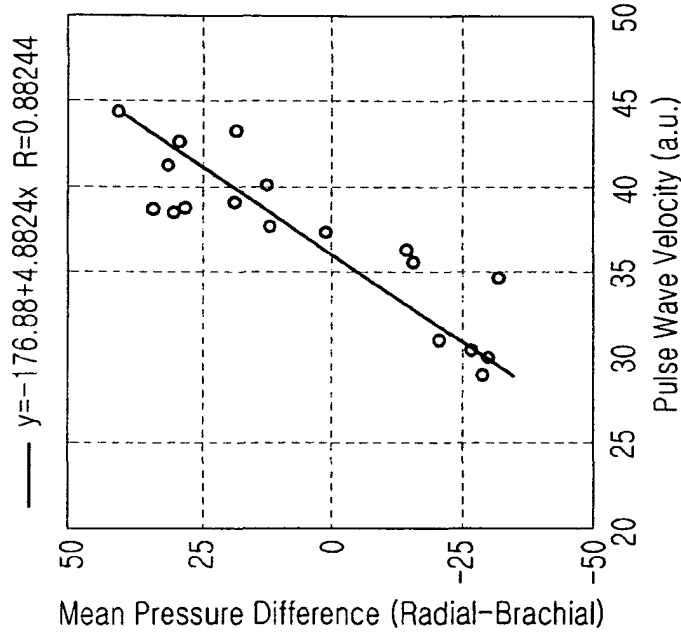


FIG.6B

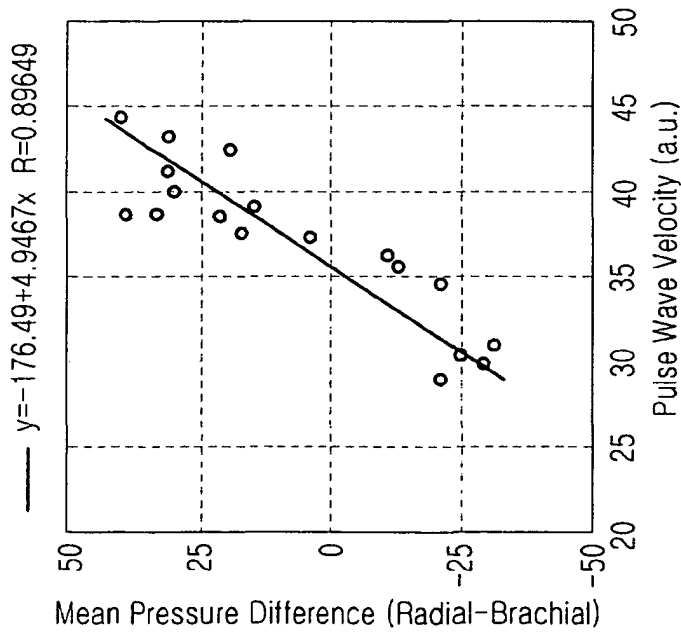


FIG.6A

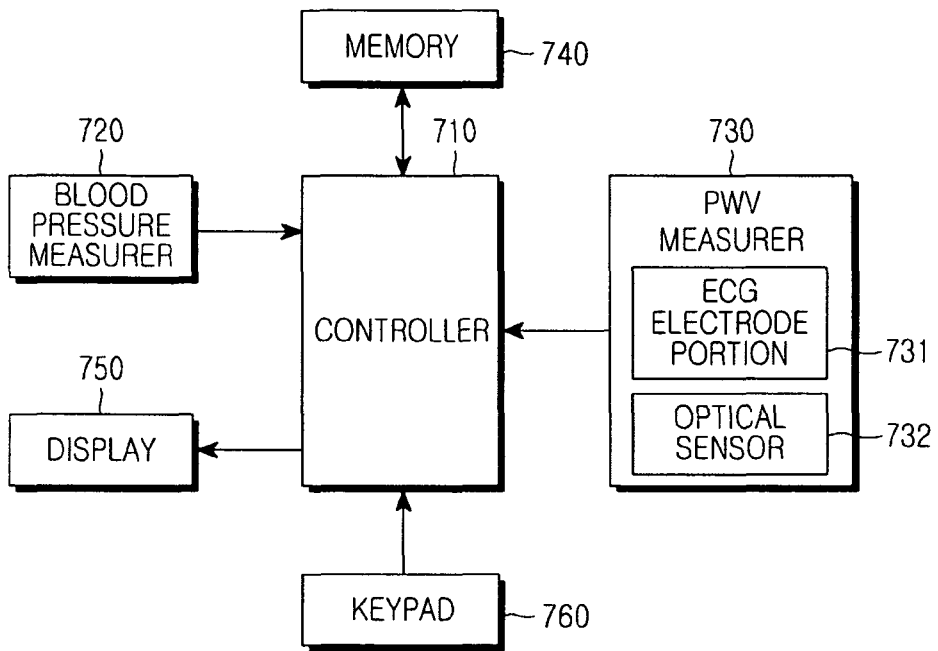


FIG. 7

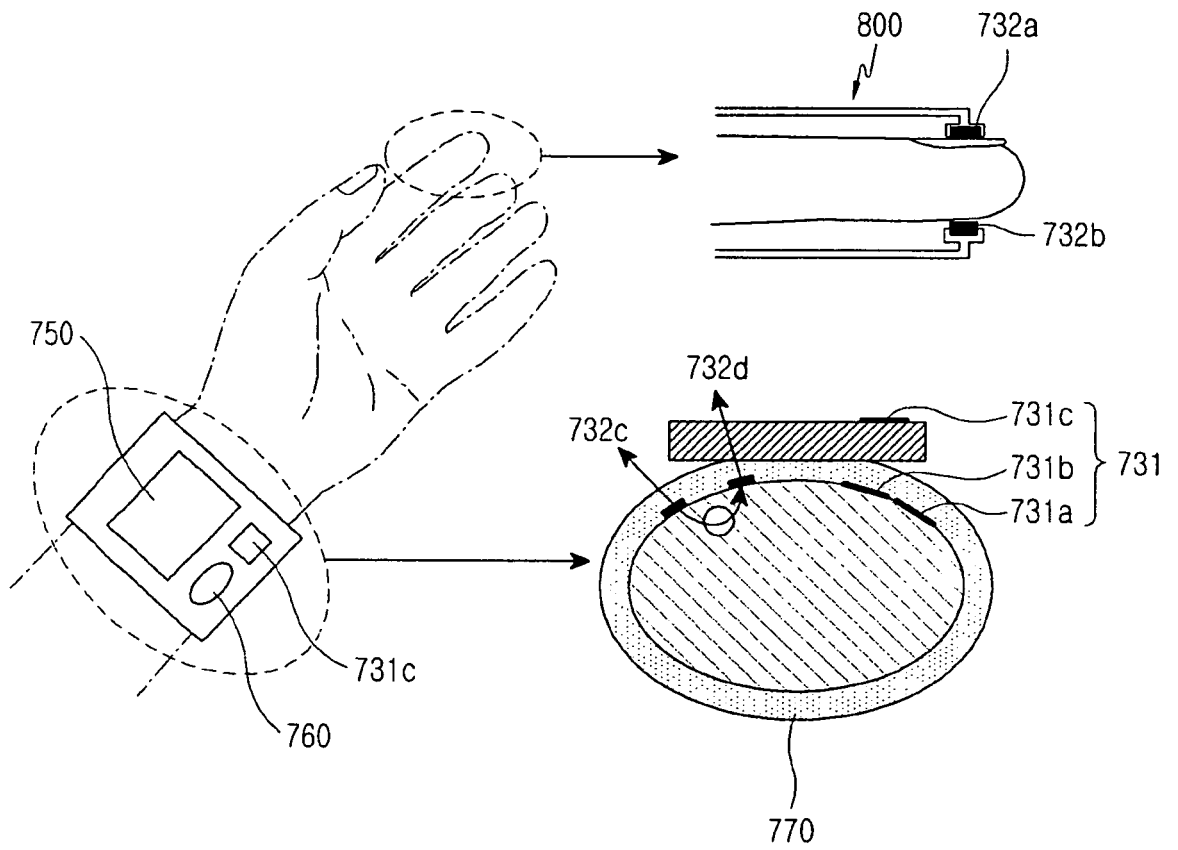


FIG.8

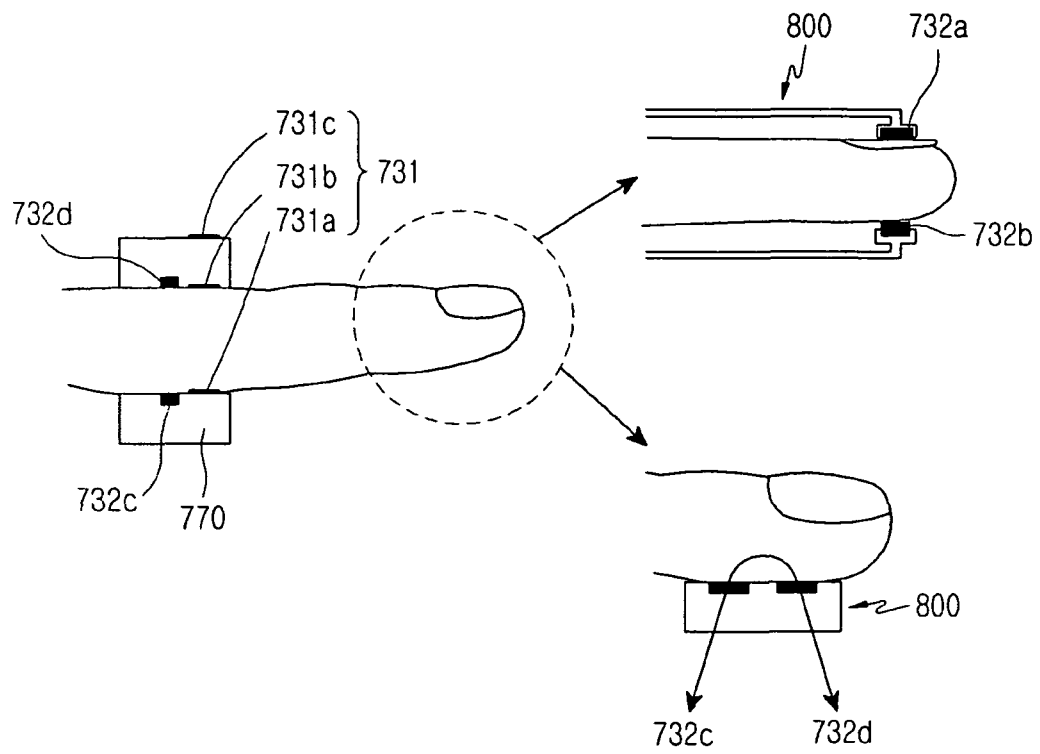


FIG.9

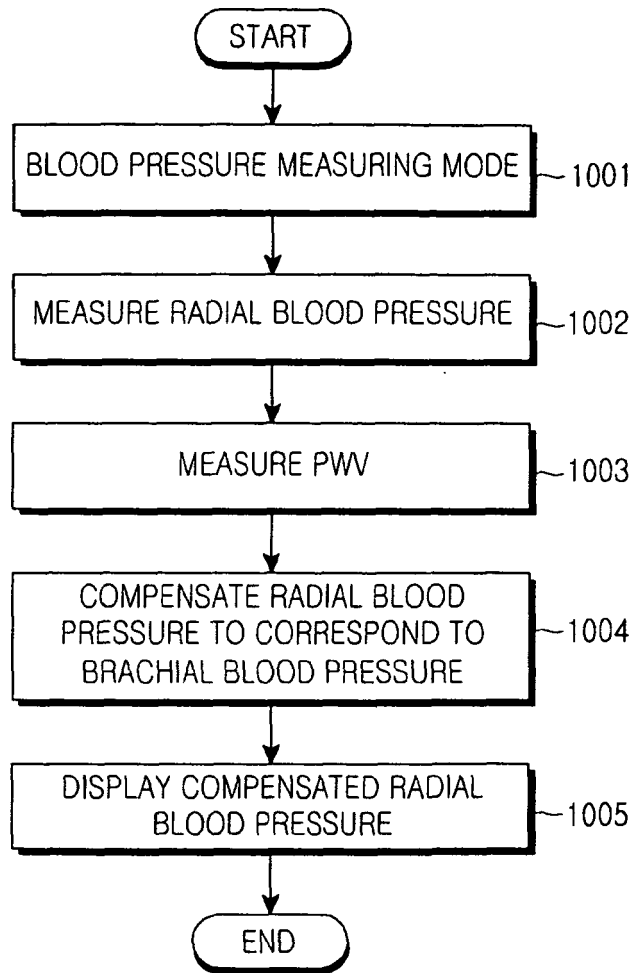


FIG.10

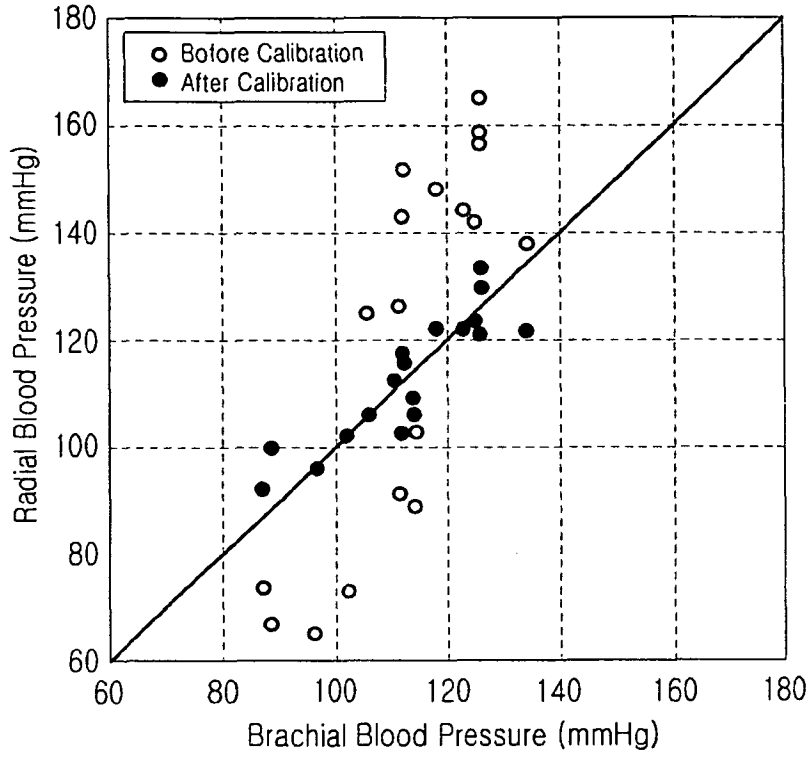


FIG.11A

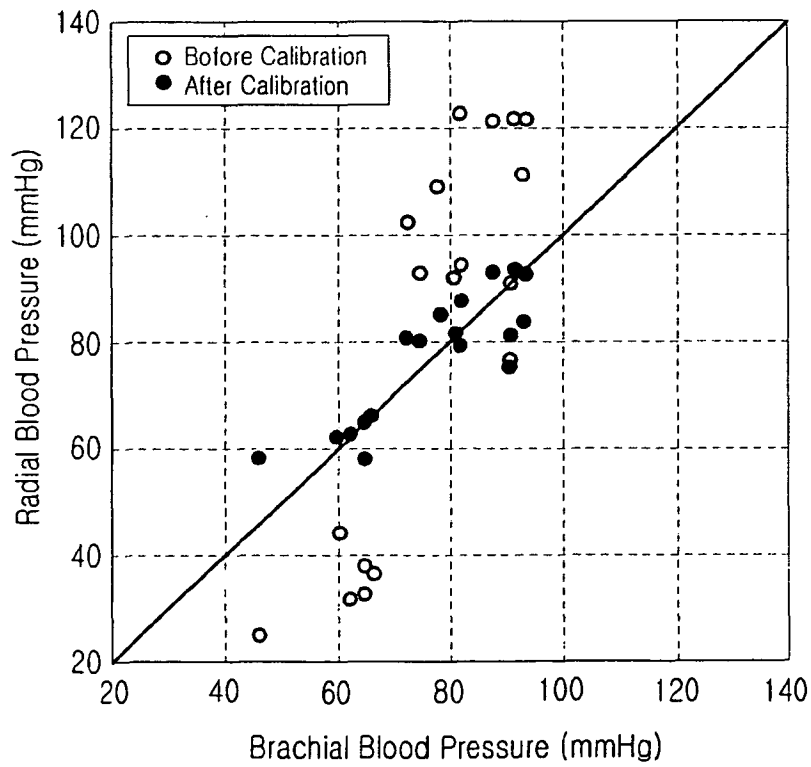


FIG.11B

专利名称(译)	便携式血压测量装置及其方法		
公开(公告)号	<a href="#">EP2191771B1</a>	公开(公告)日	2013-05-22
申请号	EP2009172991	申请日	2009-10-14
[标]申请(专利权)人(译)	三星电子株式会社		
申请(专利权)人(译)	SAMSUNG ELECTRONICS CO. , LTD.		
当前申请(专利权)人(译)	SAMSUNG ELECTRONICS CO. , LTD.		
[标]发明人	CHO JAE GEOL		
发明人	CHO, JAE-GEOL		
IPC分类号	A61B5/00 A61B5/022		
CPC分类号	A61B5/7203 A61B5/0059 A61B5/02125 A61B5/022 A61B5/02241 A61B5/0285 A61B5/0402 A61B5/681 A61B5/6824 A61B5/6826 A61B5/6838		
代理机构(译)	GRÜNECKER , KINKELDEY , STOCKMAIR & SCHWANHÄUSSER		
优先权	1020080118604 2008-11-27 KR		
其他公开文献	EP2191771A1		
外部链接	<a href="#">Espacenet</a>		

摘要(译)

提供了一种便携式血压测量装置及其方法。在便携式血压测量装置中，血压测量器测量手腕或手指血压是手腕或手指的动脉压，脉搏波速度 (PWV) 测量器测量PWV，控制器控制手腕的补偿或使用PWV手指血压使手腕或手指血压对应于肱动脉血压，并且显示器显示补偿的手腕或手指血压。

