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(54) **APPARATUS AND SYSTEM TO IDENTIFY A BLOOD PRESSURE CUFF SIZE**

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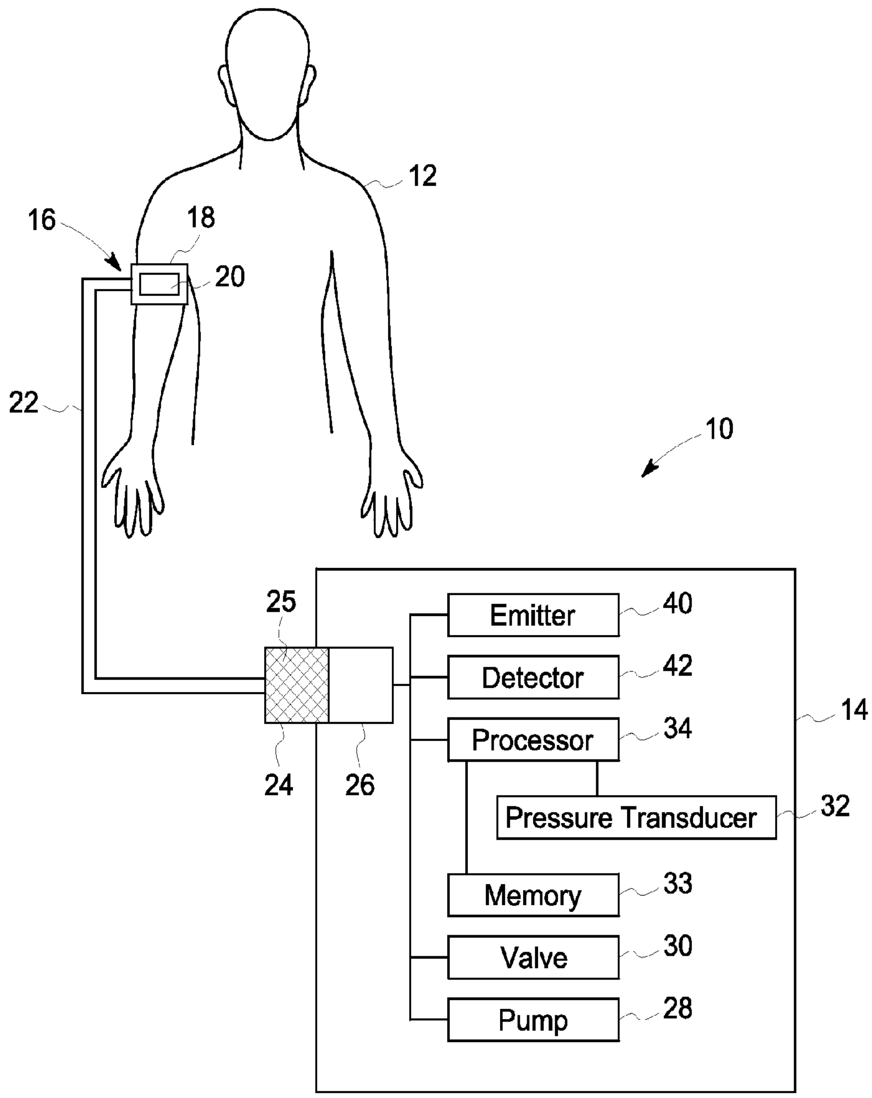
CPC *A61B 5/0082* (2013.01); *A61B 5/02233* (2013.01)

(57) **ABSTRACT**

The present application discloses a system for monitoring blood pressure. The system comprises a blood pressure cuff including a connector having an identifier associated with a blood pressure cuff size and a blood pressure measurement device comprising an emitter and a detector, the detector operatively connected to a processor. When the blood pressure cuff connector is mated with the measurement device, the emitter is positioned to direct radiation at the identifier and the detector is positioned to receive radiation from the identifier and generate a signal. The processor then determines the blood pressure cuff size based on the signal received from the detector.



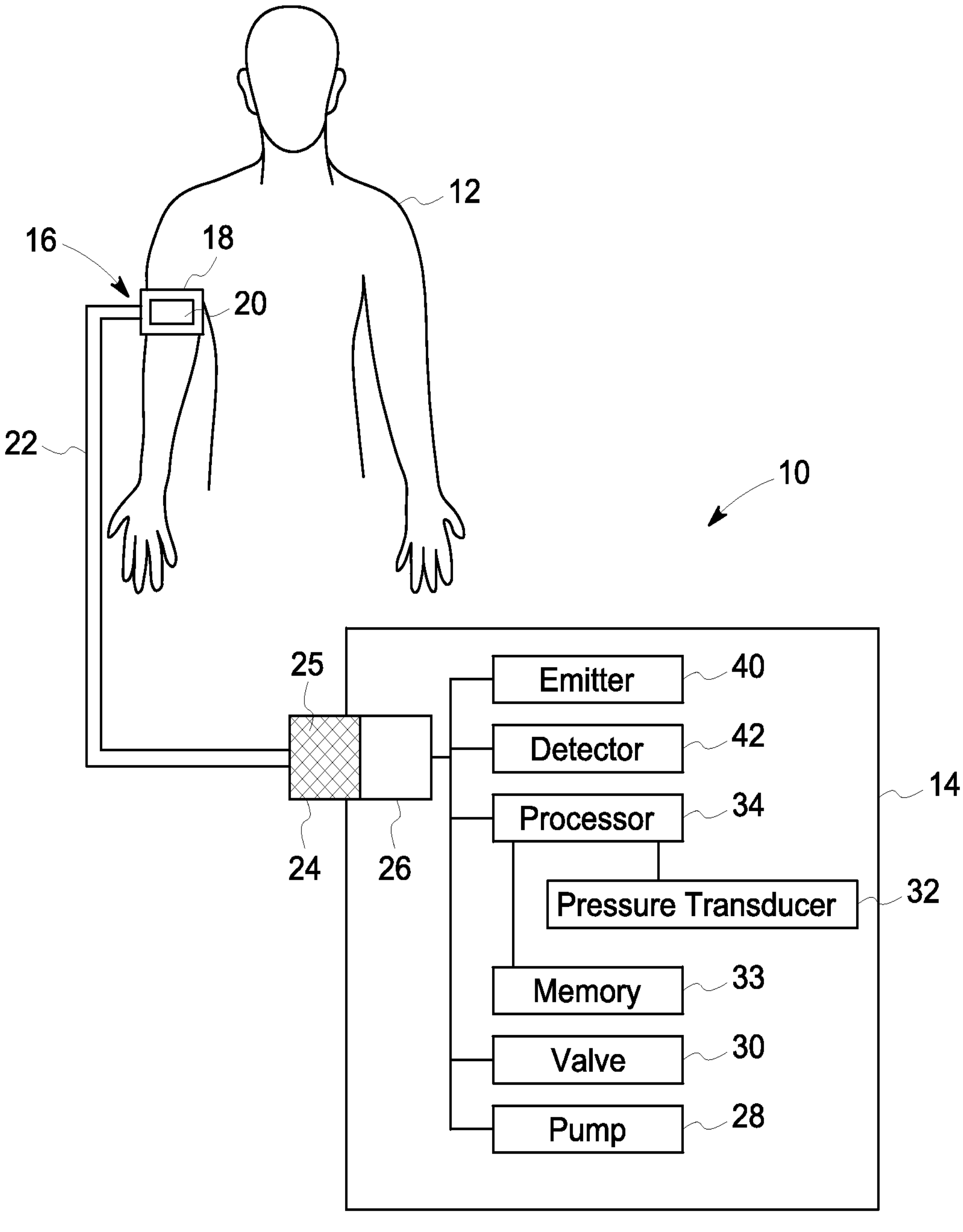

12
16
18
20
22
10
25
Emitter
40
Detector
42
14
Processor
34
24
26
Pressure Transducer
32
Memory
33
Valve
30
Pump
28

FIG. 1

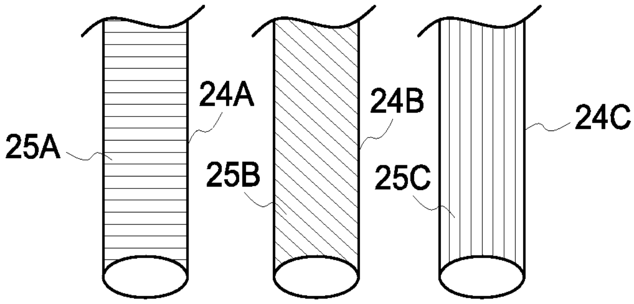


FIG. 2

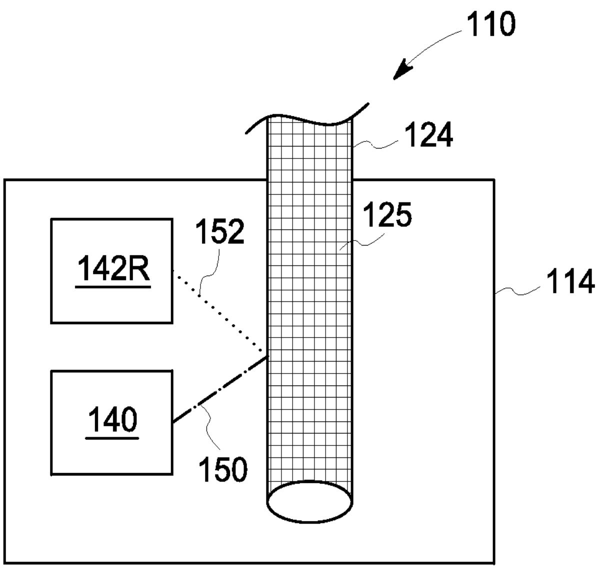


FIG. 3

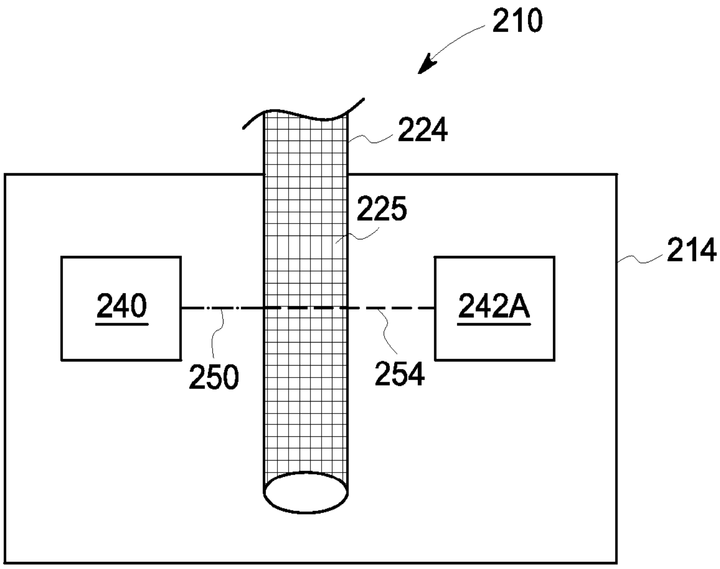

210
224
225
214
240
242A
250
254

FIG. 4

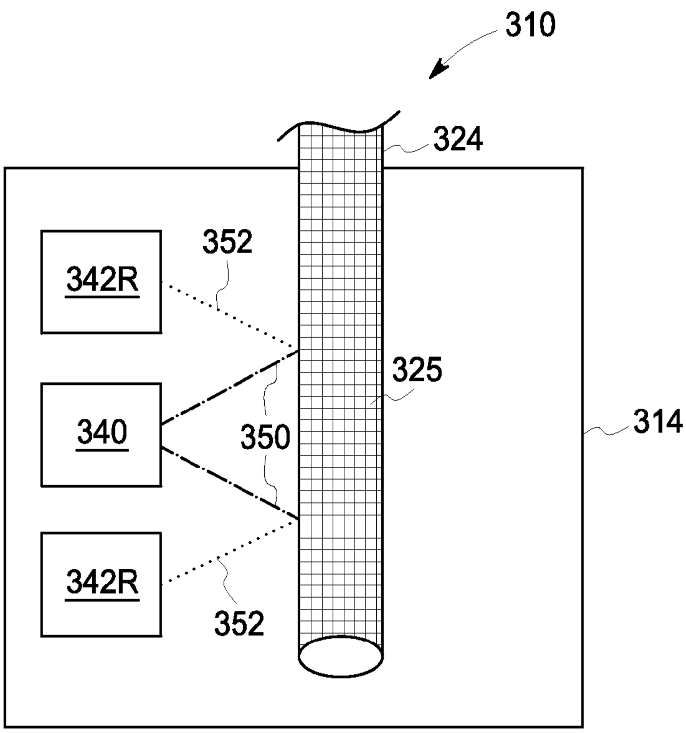

310
324
352
342R
325
314
340
350
342R
352

FIG. 5

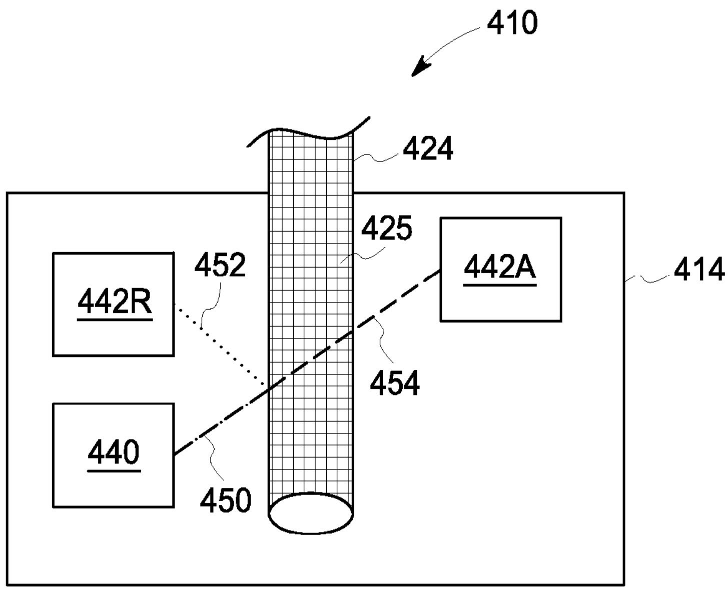

410
424
425
442A
414
442R
452
454
440
450

FIG. 6

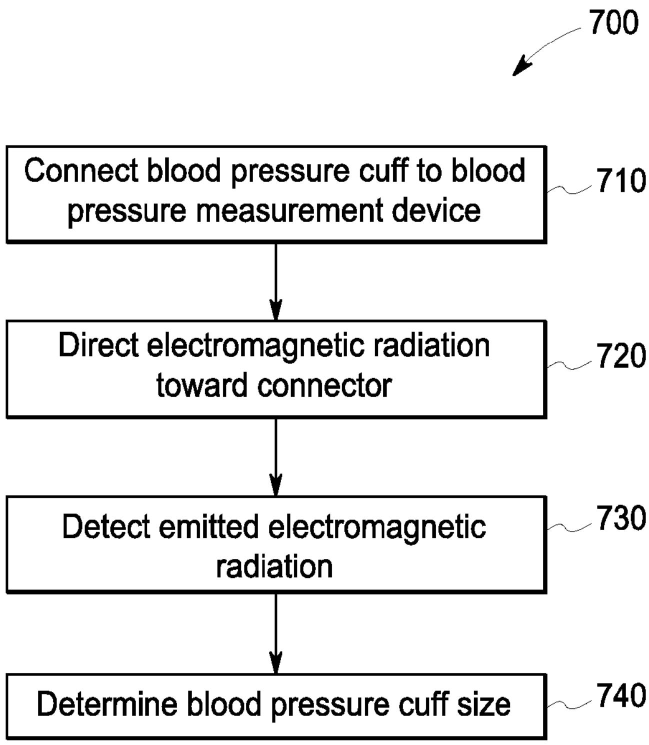

700
Connect blood pressure cuff to blood pressure measurement device
710
Direct electromagnetic radiation toward connector
720
Detect emitted electromagnetic radiation
730
Determine blood pressure cuff size
740

FIG. 7

APPARATUS AND SYSTEM TO IDENTIFY A BLOOD PRESSURE CUFF SIZE

BACKGROUND OF THE INVENTION

[0001] The subject matter disclosed herein relates to non-invasive blood pressure (NIBP) monitoring. More specifically, the present disclosure relates to an apparatus and system to identify a blood pressure cuff size.

[0002] Automated blood pressure monitoring has rapidly become an accepted and central aspect of human health care. Such monitors are now a conventional part of patient monitoring, especially in clinics, emergency rooms, intensive and critical care units, and in the operating room. As no single cuff size is effective for all possible patients, cuffs of various sizes ranging from infant or child, to large adult are used. Additionally, blood pressure measurements may be obtained at different locations on the body, such as the thigh, and additional specially sized cuffs are may be used. Using the properly sized blood pressure cuff is important because erroneous blood pressure measurements may result from using a cuff that is too large or too small.

[0003] Therefore, the appropriately sized cuff needs to be selected by the clinician, and the cuff size needs to be identified by the blood pressure measurement device. In many blood pressure monitors, the cuff size must be manually set or selected by a clinician. In other devices, the cuff size may be automatically identified via RFID, flow resistors, or by detecting cuff volume. Each of these methods, however, is flawed. Manual identification is ripe for user error. More automatic solutions, such as flow resistors, have a negative impact on performance, price and the manufacturing process by adding complexity to the blood pressure cuff.

[0004] Therefore, a reliable system and method for identifying a blood pressure cuff size is desired.

BRIEF DESCRIPTION OF THE INVENTION

[0005] The above-mentioned shortcomings, disadvantages and problems are addressed herein which will be understood by reading and understanding the following specification.

[0006] In an embodiment, a blood pressure measurement device for use with a blood pressure cuff having an identifier comprises an electromagnetic radiation emitter positioned to direct radiation onto the identifier; an electromagnetic radiation detector positioned to detect the radiation from the identifier; and a processor operatively connected to the detector, wherein the detector sends a signal to the processor, and the processor determines a cuff size based on the signal.

[0007] In another embodiment, a blood pressure cuff comprises a connector having an identifier corresponding to a blood pressure cuff size.

[0008] In another embodiment, a system for monitoring blood pressure comprises a blood pressure cuff including a connector having an identifier associated with a blood pressure cuff size and a blood pressure measurement device comprising an emitter and a detector, the detector operatively connected to a processor. When the blood pressure cuff connector is mated with the measurement device, the emitter is positioned to direct radiation at the identifier and the detector is positioned to receive radiation from the identifier and generate a signal. The processor then determines the blood pressure cuff size based on the signal received from the detector.

[0009] Various other features, objects, and advantages of the invention will be made apparent to those skilled in the art from the accompanying drawings and detailed description thereof.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010] FIG. **1** is a schematic diagram of a non-invasive blood pressure measurement system attached to a patient in accordance with an embodiment of the disclosure;

[0011] FIG. **2** is a schematic diagram of a plurality of connectors in accordance with an embodiment of the disclosure;

[0012] FIG. **3** is a schematic diagram of a blood pressure measurement device in accordance with an embodiment of the disclosure;

[0013] FIG. **4** is a schematic diagram of a blood pressure measurement device in accordance with an embodiment of the disclosure;

[0014] FIG. **5** is a schematic diagram of a blood pressure measurement device in accordance with an embodiment of the disclosure;

[0015] FIG. **6** is a schematic diagram of a blood pressure measurement device in accordance with an embodiment of the disclosure; and

[0016] FIG. **7** is a flow chart illustrating a method of determining a blood pressure cuff size in accordance with an embodiment of the disclosure.

DETAILED DESCRIPTION OF THE INVENTION

[0017] In the present description, certain terms have been used for brevity, clearness and understanding. No unnecessary limitations are to be applied therefrom beyond the requirement of the prior art because such terms are used for descriptive purposes only and are intended to be broadly construed. The different systems and methods described herein may be used alone or in combination with other systems and methods. Various equivalents, alternatives, and modifications are possible within the scope of the appended claims. Each limitation in the appended claims is intended to invoke interpretation under 35 U.S.C. §112, sixth paragraph, only if the terms "means for" or "step for" are explicitly recited in the respective limitation.

[0018] In the following detailed description, reference is made to the accompanying drawings that form a part hereof, and in which is shown by way of illustration specific embodiments that may be practiced. These embodiments are described in sufficient detail to enable those skilled in the art to practice the embodiments, and it is to be understood that other embodiments may be utilized and that logical, mechanical, electrical and other changes may be made without departing from the scope of the embodiments. The following detailed description is, therefore, not to be taken as limiting the scope of the invention.

[0019] Referring to FIG. **1**, a non-invasive blood pressure (NIBP) monitoring system **10** attached to a patient **12** is shown in accordance with an embodiment. The NIBP monitoring system **10** includes a blood pressure measurement device **14** that is releasably connected to a blood pressure cuff **16**. The blood pressure cuff **16** includes a flexible band

18. The flexible band **18** is generally wrapped around a limb of patient **12**. In FIG. **1**, the limb is depicted as comprising the patient's upper arm, however, it should be appreciated that the flexible band **18** may alternatively be applied to other locations (e.g., forearm) and other limbs (e.g., leg).

[0020] The flexible band **18** includes an inflatable bladder **20**. Although the cuff bladder **20** is shown as being an integral component of the flexible band **18**, it should be appreciated that alternative blood pressure cuff configurations may include a separate inflatable cuff bladder.

[0021] The blood pressure cuff **16** may be provided in a variety of sizes to accommodate patients of varying sizes as well as different limbs upon which blood pressure monitoring is made. The blood pressure cuff size is based on the circumference of the patient limb around which the blood pressure cuff **16** is placed and corresponds to the length of the flexible band **18**. The blood pressure cuff size can range from a neonatal class of cuffs at approximately 3 cm to 8 cm, to an infant class of cuffs at approximately 7 cm to 15 cm, to a child class of cuffs at approximately 12 cm to 21 cm, to an adult class of cuffs at approximately 20 cm to 45 cm, and to a thigh class of cuffs at 40 cm to 60 cm. Additionally, within each class of cuffs, there may be multiple sizes. For example, there may be 3 different neonatal cuffs: a small, medium and large, each sized for a range within the neonatal class.

[0022] The blood pressure cuff **16** further comprises a flexible tube **22**. Flexible tube **22** is operatively connected at a first end to the cuff bladder **20** and allows air to be pumped into, and released from cuff bladder **20**. It should be appreciated that while a single flexible tube **22** is depicted in FIG. **1**, the blood pressure cuff **16** may comprise two flexible tubes **22**. In such an embodiment, a first flexible tube **22** would direct air into the cuff bladder **20**, and while air would be released from the cuff bladder **20** via a second flexible tube **22**.

[0023] The flexible tube **22** comprises a connector **24** at its second end. The connector **24** is configured to releasably mate with of the blood pressure measurement device **14**. In one embodiment, the connector **24** mates in a snap-fit manner with a connector **26** of the blood pressure measurement device **14**. In another embodiment, the connector **24** mates in a force-fit manner with connector **26** of the blood pressure measurement device **14**. It should be appreciated that the connectors **24** and **26** may releasably mate in other manners, such as a twist-fit manner, a leur locking or a leur slipping manner, within the scope of this disclosure. Connector **24** may be either a male or female connector within the scope of this disclosure and connector **26** would be the corresponding female or male connector.

[0024] Connector **24** may comprise an identifier **25**, represented in FIG. **1** by crosshatching. The identifier **25** may correspond to a blood pressure cuff size. In one embodiment, the identifier is a color in the visible range (approximately 380-800 nm) of the electromagnetic radiation spectrum. For example, connector **25** may be comprised of a colored plastic, nylon or other petroleum-based synthetic material. Referring to FIG. **2**, a plurality of connectors **24** are shown in accordance with an embodiment. Connector **24***a* is a blue connector and the identifier **25***a* is blue. Connector **24***b* is a green connector and the identifier **25***b* is green. Connector **24***c* is a red connector and the identifier **25***c* is red. Each of the colors corresponds to a particular cuff size. While blue, green and red are used as examples, it should be appreciated that various other colors in the visible spectrum may be used to identify a specific cuff size.

[0025] In another embodiment, the identifier is a coating. For example, a coating within the ultraviolet wavelength range may be applied to the connector **24**. In another example, a coating within the infrared wavelength range may be applied to the connector **24**. In yet another example, a coating within the visible wavelength range may be applied to the connector **24**. As with the colors described above, a plurality of coatings may be used as identifiers, with each coating corresponding to a specific cuff size.

[0026] In yet another embodiment, the identifier is a surface texture. For example, the identifier may be a ridged texture with the peaks and valleys spaced at a specific interval. In another example, the identifier may be a honeycomb type texture. In yet another example, the identifier may be a perforated-type texture. Again, as with the colors described above, a plurality of textures may be used as identifiers, with each texture corresponding to a specific cuff size.

[0027] It should be appreciated that other types of identifiers or combinations thereof may be used to differentiate between cuff sizes. For example, the identifier may be a color-based pattern.

[0028] Turning back to FIG. **1**, the blood pressure monitoring device **14** includes a pump **28** adapted to inflate the cuff bladder **20**, and one or more valves **30** adapted to deflate the cuff bladder **20**. The blood pressure monitoring device **14** includes a pressure transducer **32** operable to sense or identify pressure pulses at the portion of the limb to which the blood pressure cuff **16** is attached. A processor **34** converts the pressure pulse data from the pressure transducer **32** into blood pressure data. The processor **34** may be a microprocessor and other circuitry that retrieves and executes software.

[0029] The blood pressure measurement device **14** is configured to measure mean arterial pressure (MAP), systolic blood pressure (SBP), and/or diastolic blood pressure (DBP) by inflating the blood pressure cuff bladder **20** to a supra-systolic pressure level and measuring oscillations under the blood pressure cuff bladder **20** as the cuff bladder **20** is deflated. For purposes of this disclosure, the term "oscillation" refers to a measurable pressure level pulse produced by a change in volume of an artery under the pressure cuff bladder **20**.

[0030] The blood pressure measurement device **14** further comprises an electromagnetic radiation emitter **40**. The emitter **40** is configured to direct radiation onto the connector **24**, and specifically the identifier **25**, when the connector **24** is mated with the blood pressure measurement device **14**. In one embodiment, the emitter **40** may be a light emitting diode (LED) that emits electromagnetic radiation in the visible wavelength spectrum (approximately 380-800 nm). In another embodiment, the emitter **40** may be a LED that emits radiation in the ultraviolet wavelength spectrum (approximately 10-400 nm). In yet another embodiment, the emitter **40** may a LED that emits radiation in the infrared wavelength spectrum (approximately 700 nm-1 mm). It should be appreciated that various other embodiments of the emitter **40** may be envisioned within the scope of this disclosure. For example, the emitter **40** may be a RF source. In another example, the emitter **40** may be configured to emit radiation in a plurality of spectra such as the visible spectrum and the ultraviolet spectrum. In yet another example, the emitter **40** may be an ambient light source.

[0031] The blood pressure measuring device **14** also comprises an electromagnetic radiation detector **42**. The detector **42** may be a photodetector or any other sensor configured to detect electromagnetic radiation from the emitter **40**. Depending on the positioning of the emitter **40** and detector **42** with respect to one another and the mated connector **24** having an identifier **25**, the detector **42** may detect radiation by reflection or absorption, or a combination thereof. For example, if the emitter **40** and detector **42** are placed on the same side of the connector **24**, the detector **42** may be configured to detect radiation that was reflected off of the identifier **25**. If the emitter **40** and detector **42** are placed on opposing sides of the connector **24**, the detector **42** may be configured to detect radiation by absorption.

[0032] The detector **42** may be configured to detect electromagnetic radiation in a particular spectrum. For example, the detector **42** may detect visible wavelength spectrum (approximately 380-800 nm), the ultraviolet wavelength spectrum (approximately 10-400 nm), or the infrared wavelength spectrum (approximately 700 nm-1 mm). The detector **42** may detect radiation across a plurality of spectra.

[0033] The detector **42** is configured to transmit a signal relating to the detected radiation to the processor **34**. The processor **34** may be a microprocessors, controller, microcontroller, or other logic based device, or combination thereof, that operate based on instructions stored on a tangible and non-transitory computer readable storage medium, memory **33**. The processor **34** is configured to receive the signal from the detector **42** and determine the size of the blood pressure cuff **16** mated with the blood pressure measurement device **14** via computer-readable code stored on a memory **33**. The memory **33** may also be configured to store blood pressure measurement data determined by the processor **34**.

[0034] Referring to FIG. **3**, a blood pressure monitoring system **110** according to an embodiment is shown. The blood pressure monitoring system **110** comprises a blood pressure measurement device **114** mated with a connector **124** of a blood pressure cuff (not shown). The blood pressure measurement device **114** comprises an emitter **140** that is configured to direct electromagnetic radiation **150** towards connector **124**, and more specifically towards an identifier **125**. Connector **124** comprises the identifier **125**, depicted in FIG. **3** with cross-hatching, that is associated with a specific blood pressure cuff size. The identifier **125** can be a color, a coating, a texture, or a combination thereof. The blood pressure measurement device **114** also comprises a detector **142**R that is positioned to detect electromagnetic radiation **152** that is reflected off of the connector **124**. As depicted in FIG. **3**, the emitter **140** and the detector **142** are positioned on the same side of connector **124**. It should be appreciated, however, that other configurations of the emitter **140** and detector **142** with respect to the connector **124** may be envisioned within the scope of this disclosure. For example, the emitter **140** and detector **142** may be positioned near adjacent sides of the connector **124**. The detector **142**R is configured to transmit a signal indicative of the reflected electromagnetic radiation **152** to the processor (not shown).

[0035] Referring to FIG. **4**, a blood pressure monitoring system **210** is shown according to another embodiment. The blood pressure monitoring system **210** comprises a blood pressure measurement device **214** mated with a connector **224** of a blood pressure cuff (not shown). The blood pressure measurement device **214** comprises an emitter **240** that is configured to direct electromagnetic radiation **250** towards connector **224**, and more specifically towards an identifier **225**. Connector **224** comprises the identifier **225**, depicted in FIG. **4** with cross-hatching, that is associated with a specific blood pressure cuff size. The identifier **225** can be a color, a coating, a texture, or a combination thereof. A detector **242**A is positioned to detect electromagnetic radiation **254** that is not absorbed by the connector **224**. In the depicted embodiment, the emitter **240** and detector **242** are on opposing sides of the connector **224**. It should be appreciated, however, that other configurations of the emitter **240** and detector **242** are envisioned within the scope of the disclosure. The detector **242**A is configured to transmit a signal indicative of the non-absorbed radiation **254** to the processor (not shown).

[0036] Referring to FIG. **5**, a blood pressure monitoring system **310** in accordance with another embodiment is shown. The blood pressure monitoring system **310** comprises a blood pressure measurement device **314** mated with a connector **324** of a blood pressure cuff (not shown). The blood pressure measurement device **314** comprises an emitter **340** that is configured to direct electromagnetic radiation **350** towards connector **324**, and more specifically towards an identifier **325**. Connector **324** comprises the identifier **325**, depicted in FIG. **5** with cross-hatching, that is associated with a specific blood pressure cuff size. The identifier **325** can be a color, a coating, a texture, or a combination thereof. In the depicted embodiment, the emitter **340** is configured to emit electromagnetic radiation **350** towards two different positions on connector **324**. In one embodiment, the emitter **340** may be emitting radiation in a single spectrum, such as the visible spectrum. In another embodiment, the emitter **340** may be emitting radiation in a plurality of spectra, such as the visible spectrum and the infrared spectrum.

[0037] The blood pressure measurement device **314** also comprises a plurality of detectors **342**R that are positioned to detect electromagnetic radiation **352** that is reflected off of the connector **324**. The depicted embodiment comprises two detectors **342**R, however it should be appreciated that additional detectors may be used within the scope of the disclosure. In one embodiment, the detectors **342**R may be configured to both detect radiation in the same spectrum, such as the visible spectrum. In another embodiment, the detectors **342**R are each configured to detect radiation in separate spectra, such as the visible spectrum and the infrared spectrum. The detectors **342**R are both configured to transmit a signal indicative of the detected reflected electromagnetic radiation **352** to the processor (not shown).

[0038] Referring to FIG. **6**, a blood pressure monitoring system **410** in accordance with yet another embodiment is shown. The blood pressure monitoring system **410** comprises a blood pressure measurement device **414** mated with a connector **424** of a blood pressure cuff (not shown). The blood pressure measurement device **414** comprises an emitter **440** that is configured to direct electromagnetic radiation **450** towards connector **424**, and more specifically towards an identifier **425**. Connector **424** comprises the identifier **425**, depicted in FIG. **6** with cross-hatching, that is associated with a specific blood pressure cuff size. The identifier **425** can be a color, a coating, a texture, or a combination thereof. The blood pressure measurement device **414** also comprises detectors **442**R, **442**A. Detector **442**R is positioned to detect electromagnetic radiation **452** that is reflected off of the connector **424**. Detector **442**A is positioned to detect electromagnetic radiation **454** that is not absorbed by the connector **424**. Detectors **442**R and **442**A are configured to send a signal to the processor (not shown) relating to the detected radiation.

[0039] Referring to FIG. **7**, a method **700** of identifying a blood pressure cuff size is disclosed. For the purposes herein, reference numerals will refer to the system depicted in FIG. **1**. It should be appreciated, however that the method may be carried out with any of the systems depicted in FIGS. **3-6**.

[0040] The method **700** includes a step **710** comprising connecting the blood pressure cuff **16** to the blood pressure measurement device **14**. The blood pressure cuff **16** comprises connector **24** having an identifier **25**. The identifier **25** is associated with the size of the blood pressure cuff, and more specifically the identifier **25** may be associated with the size of the flexible band **18**. The identifier **25** may be a color, a coating, or a texture, or a combination thereof.

[0041] The method **700** includes a step **720** comprising emitting with emitter **40** electromagnetic radiation directed towards the connector **24** having an identifier **25**. The electromagnetic radiation may be in the visible wavelength spectrum (approximately 380-800 nm), the ultraviolet wavelength spectrum (approximately 10-400 nm), or the infrared wavelength spectrum (approximately 700 nm-1 mm), or any other spectrum of electromagnetic radiation. The emitter may direct electromagnetic radiation of one spectrum or a plurality of spectra towards the connector **24**.

[0042] The method **700** includes a step **730** comprising detecting with the detector **42** the electromagnetic radiation emitted from the emitter **40**. Depending on the positioning of the detector **42** with respect to the emitter **40** and the identifier **25**, the detector **42** may detect radiation that is reflected off the connector **24**, radiation that passes through the connector **24**, or a combination thereof.

[0043] The method **700** includes a step **740** comprising determining with the processor **34** the blood pressure cuff size. The processor **34** is configured to receive a signal from the detector **42** indicative of the detected radiation. The processor **34** is configured to associate the detected radiation with a blood pressure cuff size using computer executable code stored on the memory **33**.

[0044] The apparatus, system and method disclosed herein have several benefits over existing means for identifying blood pressure cuff size. First, it eliminates the user error that is possible in systems that require a manual identification and selection or input of blood pressure cuff size. Second, it produces an economic benefit. No changes or complexities are added to current blood pressure cuff manufacturing processes. Third, system flexibility is increased as a large number of cuff identifiers may be recognized.

[0045] This written description uses examples to disclose the invention, including the best mode, and also to enable any person skilled in the art to practice the invention, including making and using any devices or systems and performing any incorporated methods. The patentable scope of the invention is defined by the claims, and may include other examples that occur to those skilled in the art. Such other examples are intended to be within the scope of the claims if they have structural elements that do not differ from the literal language of the claims, or if they include equivalent structural elements with insubstantial differences from the literal language of the claims.

We claim:

1. A blood pressure measurement device for use with a blood pressure cuff having an identifier, the blood pressure measurement device comprising:

an electromagnetic radiation emitter positioned to direct radiation onto the identifier;

an electromagnetic radiation detector positioned to detect the radiation from the identifier; and

a processor operatively connected to the detector, wherein the detector sends a signal to the processor, and the processor determines a cuff size based on the signal.

2. The device of claim **1**, wherein the emitter directs radiation in the visible wavelength range.

3. The device of claim **1**, wherein the emitter directs radiation in the ultraviolet wavelength range.

4. The device of claim **1**, wherein the detector is positioned to detect radiation by reflection.

5. The device of claim **1**, wherein the detector is positioned to detect radiation by absorption.

6. A blood pressure cuff, comprising:

a connector having an identifier corresponding to a blood pressure cuff size.

7. The blood pressure cuff of claim **7**, wherein the identifier is a color.

8. The blood pressure cuff of claim **7**, wherein the identifier is a coating.

9. The blood pressure cuff of claim **7**, wherein the identifier is a texture.

10. A system for monitoring blood pressure, comprising:

a blood pressure cuff comprising a connector having an identifier associated with a blood pressure cuff size; and

a blood pressure measurement device comprising an emitter and a detector, the detector operatively connected to a processor;

wherein when the blood pressure cuff connector is mated with the measurement device, the emitter is positioned to direct radiation at the identifier and the detector is positioned to receive radiation from the identifier and generate a signal, wherein the processor determines the blood pressure cuff size based on the signal received from the detector.

11. The system of claim **10**, wherein the emitter directs electromagnetic radiation in the visible wavelength range.

12. The system of claim **10**, wherein the emitter directs electromagnetic radiation in the ultraviolet wavelength range.

13. The system of claim **10**, wherein the detector is positioned to detect radiation by reflection.

14. The system of claim **10**, wherein the detector is positioned to detect radiation by absorption.

15. The system of claim **10**, wherein the blood pressure measurement device comprises a first detector positioned to detect radiation by reflection and a second detector positioned to detect radiation by absorption.

16. The system of claim **10**, wherein the identifier is a color.

17. The system of claim **10**, wherein the identifier is a coating.

18. The system of claim **10**, wherein the identifier is a texture.

* * * * *

专利名称(译)	用于识别血压袖带尺寸的装置和系统		
公开(公告)号	US20170086677A1	公开(公告)日	2017-03-30
申请号	US14/870787	申请日	2015-09-30
[标]申请(专利权)人(译)	通用电气公司		
申请(专利权)人(译)	通用电气公司		
当前申请(专利权)人(译)	通用电气公司		
[标]发明人	PEKANDER OTTO VALTTERI KARRU KRISTIAN MATTI		
发明人	PEKANDER, OTTO VALTTERI KARRU, KRISTIAN MATTI		
IPC分类号	A61B5/00 A61B5/022		
CPC分类号	A61B5/02233 A61B5/0082 A61B5/022 A61B90/98 A61B2560/0443 A61B2562/08		
外部链接	Espacenet USPTO		

摘要(译)

本申请公开了一种用于监测血压的系统。该系统包括血压袖带，该血压袖带包括具有与血压袖带尺寸相关联的标识符的连接器和包括发射器和检测器的血压测量装置，该检测器可操作地连接到处理器。当血压袖带连接器与测量装置配合时，发射器定位成将辐射定向在标识符处，并且检测器定位成接收来自标识符的辐射并产生信号。然后，处理器基于从检测器接收的信号确定血压袖带尺寸。