US009510775B2

(12) United States Patent
Morren et al.

(10) Patent No.: US 9,510,775 B2
(45) Date of Patent: Dec. 6, 2016

(54) **MOTION DETERMINATION APPARATUS**

(75) Inventors: **Geert Guy Georges Morren**, Tienen (BE); **Anmin Jin**, Eindhoven (NL); **Bin Jin**, Eindhoven (NL); **Haris Duric**, Eindhoven (NL); **Ronaldus Maria Aarts**, Eindhoven (NL)

(73) Assignee: **KONINKLIJKE PHILIPS N.V.**, Eindhoven (NL)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 936 days.

(21) Appl. No.: **13/320,029**

(22) PCT Filed: **Jun. 2, 2010**

(86) PCT No.: **PCT/IB2010/052466**

§ 371 (c)(1), (2), (4) Date: **Nov. 11, 2011**

(87) PCT Pub. No.: **WO2010/140130**

PCT Pub. Date: **Dec. 9, 2010**

(65) **Prior Publication Data**

US 2012/0065524 A1 Mar. 15, 2012

(30) **Foreign Application Priority Data**

Jun. 5, 2009 (EP) 09162004

(51) **Int. Cl.**

A61B 5/08 (2006.01)
A61B 5/11 (2006.01)
A61B 5/113 (2006.01)

(52) **U.S. Cl.**

CPC ***A61B 5/1102*** (2013.01); ***A61B 5/1135*** (2013.01); *A61B 2562/0219* (2013.01)

(58) **Field of Classification Search**

USPC 600/484
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

7,827,011 B2 * 11/2010 DeVaul et al. 702/190
8,103,304 B1 * 1/2012 Miller H04M 1/72569 455/550.1

(Continued)

FOREIGN PATENT DOCUMENTS

JP	200534364		2/2005
JP	2006320734	A	11/2006
WO	2004043263	A2	5/2004
WO	2005048824	A2	6/2005

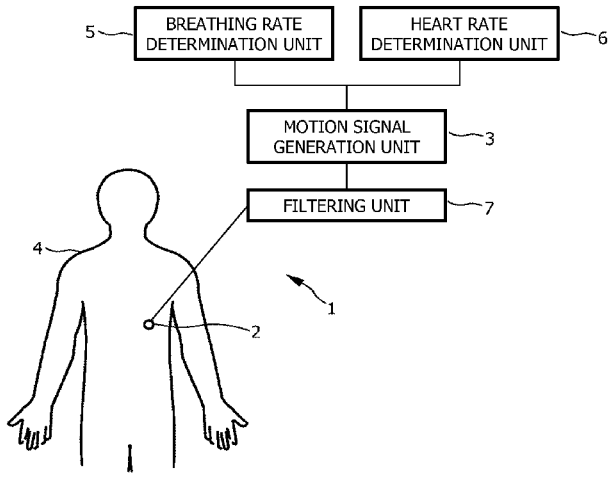
OTHER PUBLICATIONS

Estimation of respiratory waveform and heart rate using an accelerometer, D. H. Phan.*

(Continued)

Primary Examiner — Michael Kahelin
Assistant Examiner — Mitchell E Alter

(57) **ABSTRACT**

The invention relates to a motion determination apparatus for determining motion of a moving object, wherein the motion determination apparatus (**1**) comprises a multi-axial accelerometer (**2**) for being positioned at the moving object (**4**), wherein the multi-axial accelerometer (**2**) is adapted to generate accelerometer signals indicative of the acceleration along different spatial axes. The motion determination apparatus further comprises a motion signal generation unit (**3**) for generating a motion signal indicative of the motion of the object (**4**) by combining the accelerometer signals of different spatial axes. The combination of the accelerometer signals of different spatial axes yields a motion signal having a large signal-to-noise ratio, even if an axis is located close to a rotational axis of the movement.

14 Claims, 6 Drawing Sheets