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(54) Title: A DEVICE FOR ASSESSING THE ACTIVITY OF OFFICE WORKERS AND WORK ENVIRONMENT RISK FACTORS

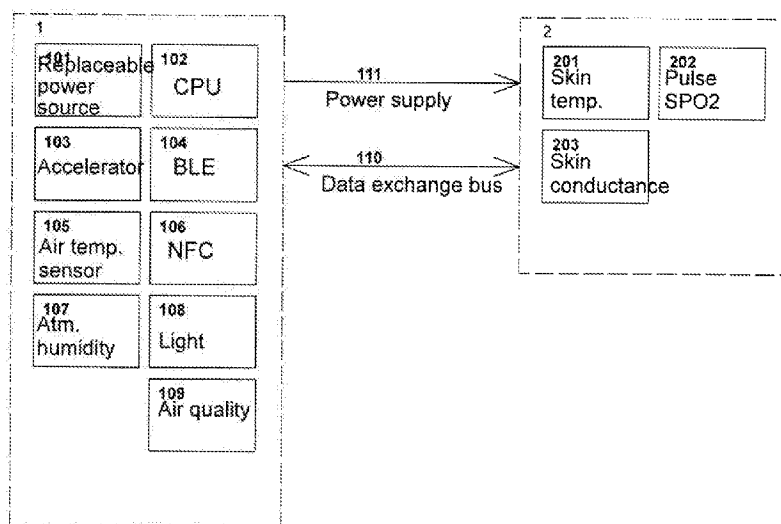


FIG 1

(57) Abstract: The present invention relates to a device to evaluate the activity and to assess the occupational exposure of the office worker. The device monitors the physical movement and activity of the carrier and evaluates the risk factors of the physical work environment. Occupational parameters are monitored by air temperature sensor, humidity sensor, light intensity sensor, air quality sensor and human activity is monitored by heart rate sensor, 3-axis accelerometer, skin surface temperature sensor and skin conductivity sensor. The parameters measured by the sensors are compared with the normative parameters and the carrier will be alerted if the normative parameters have been exceeded.



## **A device for assessing the activity of office workers and work environment risk factors**

### TECHNICAL FIELD

The invention belongs to the field of electronics and is designed to monitor the activity of office workers and assess work environment risk factors.

### BACKGROUND OF THE INVENTION

Smartwatches that measure the user's pulse, count their steps and the amount of calories spent are known from the state of the art. However, these devices do not assess or collect data about the environment surrounding the wearer of the device.

Similarly, sports watches that measure the user's activity and primarily focus on athletic activities, such as swimming, running, cycling, and hiking, are known from the state of the art. Sports watches measure the users' activities better than smartwatches presented as an example above, but sports watches also do not assess the physical risk factors of the environment surrounding the wearer. Furthermore, sports watches are expensive.

Different smartbands designed for medical purposes are also known from the state of the art. The primary function of these smartbands is to monitor a specific health condition, such as epilepsy or blood pressure, or to monitor the operation of a pacemaker. However, these devices also do not assess the environment surrounding the wearer of such a device. In addition, such devices are expensive and still under development.

A solution to assess the physical risk factors of a work environment which shares the parameters of a particular building via the central control system of the building is known from the state of the art. However, the measured values thus obtained are a generalisation, as the average parameters of a particular room are measured. Furthermore, the measurement is limited to only some physical risk factors, such as air temperature and indoor air quality. This method of measuring is only possible if a respective central control system has been installed in the building.

Additionally, a solution for assessing the physical risk factors of a work environment by measuring the general lighting is known from the state of the art. However, this solution is primarily designed to switch the lighting on or off by means of a time programme or twilight switch values. The lighting parameters of a person's workplace are not assessed by means of this solution.

The closest solution known from the state of the art is described in document CN204158366U (18 February 2015). A multifunctional wristlet made up of a housing containing a microprocessor, body temperature sensor, pulse sensor, screen, and alarm, which are connected to the microprocessor, is described in the aforementioned Chinese utility model. The microprocessor is wirelessly connected to the computer of a nurse in charge. The aforementioned multifunctional wristlet is designed for continuous monitoring and storing of a person's physiological data.

A weakness of the above wristlet is that it cannot be used for monitoring the physical parameters of the environment surrounding the user, for example, air temperature, atmospheric humidity, indoor air quality, and lighting.

#### SUMMARY OF THE INVENTION

The objective of this invention is to develop a device whose function is to monitor the physical movement and activity of the wearer of the device as well as to assess the physical risk factors of the respective work environment. Good health is an important foundation of professional and social activity. The unhealthy lifestyles, poor state of healthy, and incidents of premature death of the working-age population render it impossible to make full use of the potential of the labour force, affecting labour supply and the productivity of employees.

The average workday of an employed person (incl. at weekends) is 5 hours and 45 minutes on average, and during this time, the productivity of workers is affected by physical risk factors that endanger the work environment, such as air temperature, atmospheric humidity, indoor air quality, and lighting, which are measurable parameters. If these parameters exceed the standard limits, workers experience nose, throat and eye irritation, dryness and redness of the mucous membranes and

body, mental fatigue and headaches; they feel generally bad and suffer from dizziness.

The essence of this invention is an operating principle of data exchange between different sensors. An air temperature sensor, atmospheric humidity sensor, light intensity sensor, and air quality sensor monitor the parameters of work environments; a pulse sensor, triaxial accelerometer, skin surface temperature sensor, and skin conductance sensor monitor human activity. The sensors are chosen so that they have their own internal storage capacity for storing data, and any stored data is transmitted to the central processor by means of a two-wire interface. When such a solution is implemented, there is no need for extra storage capacity for data storage, and a lower-performance central processor can be chosen, which in turn helps economise on the size of the electronic components and power consumption. A passive near-field data communication chip is provided for identifying personal data in access systems and for storing norm parameters. These norm parameters are the basis for assessing the measurement results stored by the technical solution. The parameters stored in the device can be synchronised with a specific application by means of a Bluetooth data communication application.

#### DRAWINGS

The above and other features and advantages of the invention are described in more detail below with references to the attached drawings that illustrate the preferred embodiments, where:

Fig. 1 represents a plan of the device of the invention.

Fig. 2 represents a cross-section of the device.

Fig. 3 represents a top view of the device.

Fig. 4 represents the assembly of the device.

Fig. 5 represents a block diagram of the operation of the device.

#### DETAILED DESCRIPTION OF THE INVENTION

Figs. 1–4 represent plans of the device of the invention, where the numbers on the plan denote the following:

- 1 - upper section of the device that is fitted on the wrist;
- 10 - acrylic stick;
- 12 - red indicator light;
- 13 - yellow indicator light;
- 20 - housing;
- 21 - bottom plate;
- 22 - fastening screws of the bottom plate;
- 23 - external edge under a 45-degree angle;
- 24 - battery holder;
- 25 - battery;
- 30 - USB connecting cable opening;
- 31 - USB connecting cable port;
- 32 - battery power supply negative wire pos. 1;
- 33 - battery power supply positive wire pos. 1;
- 40 - adjustable strap of the device;
- 41 - pins to attach the strap to the housing;
- 42 - locking hole of the fastening pins of the strap;
- 101 - replaceable power source;
- 102 - central processor for data collection;
- 103 - triaxial accelerometer for movement detection;
- 104 - Bluetooth BLE for data synchronisation;
- 105 - air temperature sensor;
- 106 - passive near-field data communication chip;
- 107 - atmospheric humidity sensor;
- 108 - light intensity sensor;
- 109 - air quality sensor;
- 110 - data exchange bus;
- 111 - power supply;
- 2 - lower section of the device that is fitted on the wrist;
- 201 - skin surface temperature sensor;
- 202 - pulse, blood oxygen content sensor;
- 203 - skin conductance (resistance) sensor.

The device comprises three main components, which are its housing 20, which includes a triaxial accelerometer 103, a central processor 102, a USB connecting cable port 31, a replaceable power source 101, Bluetooth BLE 104, an air temperature sensor 105, an atmospheric humidity sensor 107, a light intensity sensor 108, an air quality sensor 109, a passive near-field data communication chip 106. There is also an adjustable strap 40, and a lower section 2, which is in the adjustable strap and is supported on the lower side of the user's wrist; the lower section contains a skin temperature sensor 201, pulse sensor 202, and skin resistance sensor 203. The power source of the device is a regular battery 25, which can be replaced once the respective red indicator light 12 lights up. If possible, an alternative where the user of the device can use a rechargeable battery instead of the regular battery 25 is implemented. The choice of battery is based on the external dimensions and capacity of the battery. The battery is charged via a USB port 31. The red indicator light 12, which is also integrated into the device, notifies the user of the need to charge the battery. The power source 101 of the device supplies the device's lower 2 and upper 1 sections, which are fitted on the user's wrist, with the required amount of power. Power is transmitted from the power source first to the upper 1 section of the wrist by means of two wires, therefrom forward to the lower 2 section of the wrist by means of a so-called flat cable, which is integrated into the adjustable strap 40 of the device and is made up of two parts: a data communication part 110 and a power transmission part 111. The strap 40 of the device can be adjusted by means of a Velcro-type strip. The strap is attached to the housing by means of pins, which are locked into the respective openings 42 in the housing. The device is capable of Bluetooth BLE data communication via which the data stored on the device is downloaded by means of a specific application installed on the smart device beforehand.

The device is designed to be worn on the wrist of the user's right or left hand. For the best measurement results, the device must be attached to a distance of two fingers from the wrist and tightened to a reasonable degree, so that the device would not move back and forth on the wrist, or rotate around the wrist. It is important not to cover the device completely.

A software application designed for that purpose must be used to display the data stored on the device as well as the pre-determined parameters. The device can be installed both on a personal computer and a smart device. The user of the device enters the following data via the application when the device is first used (the values can be adjusted later):

1. Body weight
2. Sex
3. Age
4. Working hours (beginning and end, weekdays)
5. Activation of the NFC chip of the access system (activation takes place if the respective device can be activated and registered in the access system of the working place)

The red 12 and a yellow 13 indicator light installed on the device notify its user of the need to replace the battery or of a potential deviation in the measured air parameter values when the red and yellow indicator light up respectively. The limits of air temperature, atmospheric humidity, air quality, and light intensity are pre-entered.

The edges of the device, which are positioned transversely to the wrist, are at a 45-degree angle 23. The aim is to perform measurements also in situations where the wearer of the device is wearing, for example, a long-sleeved shirt. Light-transmitting acrylic sticks 10 are additionally installed on the device. The device registers the air temperature, humidity and quality of the ambient environment, and the acrylic sticks communicate the light intensity.

Fig. 5 represents a block diagram. When the device is first taken into use, the user must enter the number of working hours, the beginning and end of their workday, and the weekdays on which the working hours apply 1001. In addition, when the device is set up, it must be determined whether the activity of the wearer is also monitored outside these working hours. The wearer of the device can use the device as an activity monitor, for example during sporting, via this option. If the given option is not chosen, the device switches to its power saving mode after the end of the workday and remains in this mode until the next cycle begins at the beginning of the

next workday. When the given cycle is initiated, the battery level is first checked, and if the level is within the allowed limits, the different sensors of the device, the processors, and cache memory of the device are activated. If the volume is under the allowed limit, the wearer of the device will be notified of the need to change the power source by the red indicator light 12.

The triaxial accelerometer 103 is used to monitor the wearer's movements/immobility 1002. If a so-called standstill of the wearer of the device is detected during a specific period, a command is given to the light sensor 108 to store the measured value 1003. During this period, the interval of storing values is tighter. Any stored values are stored in the internal cache memory of the light sensor 108 itself in the first stage. When the memory gets full, or by request from the central processor, the data in the cache memory of the light sensor 108 is transmitted to the memory of the central processor. By means of a specific application of the wearer of the device, the results of the data stored in the memory of the central processor can then be viewed.

The values of the sensors (the air temperature sensor 105, the atmospheric humidity sensor 107, and the air quality sensor 109) that measure environmental parameters are stored on a similar principle. Only the values of these sensors are stored at a specific interval during all the allowed working hours. Similarly, the values measured in the first stage are stored in the internal cache memory of these sensors, and when the cache memory becomes full, or by request from the central processor, the data stored in the cache memory of the sensors is sent to the memory of the central processing unit (CPU) 102.

The central processor analyses the stored information flow and compares the information flow with the values pre-determined by the user 1004.

The results of the data stored in the memory of the central processor can be viewed by means of a specific application of the wearer of the device. Communication between the central processor and sensors takes place by means of a two-wire interface, which, in other words, means that the sensors process the data stored in the first stage on their own, and in the second stage, any data stored in the first

stage is transmitted when the cache memory of a specific sensor becomes full, or by request from the central processor.

The operating principles of the sensors that monitor the activity of the wearer of the device (skin temperature sensor 201, skin conductance sensor 203, pulse (PPG) sensor 202)) are similar to those of the sensors that monitor the environment. The values of the sensors are stored at a specific interval during all the allowed working hours. Similarly, the values measured in the first stage are stored in the internal cache memory of these sensors, and when the cache memory becomes full, or by request from the central processor, the data stored in the cache memory of the sensors is sent to the memory of the central processing unit.

In the event that a constant excess of the provided parameters is detected, the yellow indicator light of the device will light up to notify the user of a potential danger existing in the work environment 1005. The cycle will last until the end of the working hours set by the user 1006. The device will switch to its power saving mode; no data will be monitored or stored 1007.

The cycle returns to the beginning 1008.

By means of a specific application of the wearer of the device, the results of the data stored in the memory of the central processor can then be viewed. Communication between the central processor and sensors takes place by means of a two-wire interface.

The four fastening screws 22 of the bottom of the housing 20 must be loosened to replace the power source of the device. Doing so enables the user to remove the bottom plate 21 of the housing. When the bottom plate 21 is removed, the user gains access to the battery 25 of the device and can replace the power source with a new one. The device is assembled in a reverse order. Rechargeable batteries are replaced similarly to the process of replacing the battery 25.

## Claims

1. A device designed for assessing the activity of office workers and work environment risk factors, wherein the device comprises a housing (20) into which an upper section (1) has been integrated, and a power source (101), triaxial accelerometer (103), central processor (102), Bluetooth (104), and NFCs (106) are connected to the upper section (1);

a strap (40) of adjustable length is integrated with the housing (20), into which, in turn, a flat cable has been integrated for establishing a data connection (110) between the different components and for supplying all the necessary components with power (111);

and a lower section (2) is integrated with the strap (40) of adjustable length, to which, in turn, a skin temperature sensor (201), pulse sensor (202), and skin resistance sensor (203) are connected,

**characterized in that** an air temperature sensor (105), atmospheric humidity sensor (105), air quality sensor (109), and light intensity sensor (108) are connected to the upper section (1).

2. The device according to claim 1, **characterized in that** the power source (101) is a battery (25).

3. The device according to claim 1, **characterized in that** the power source (101) is a rechargeable battery.

4. The device according to claims 1–3, **characterized in that** the power source (101) is connected to an indicator light (12) to notify the user of power source (101) depletion.

5. The device according to claim 1, **characterized in that** the device is designed to be worn on both the left and right hand.

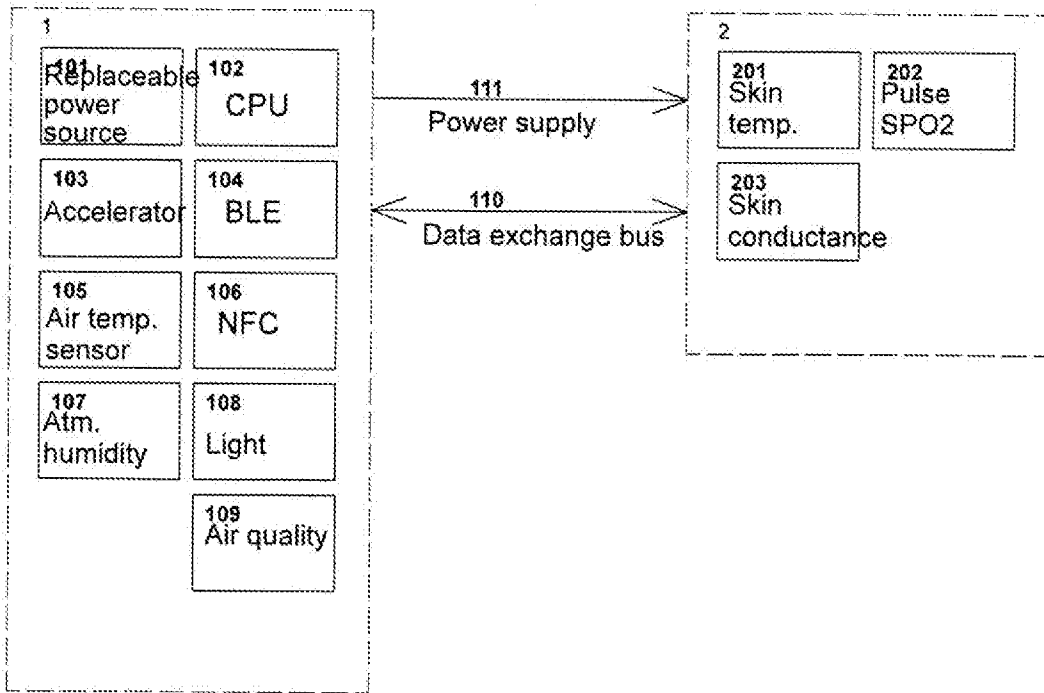


FIG 1

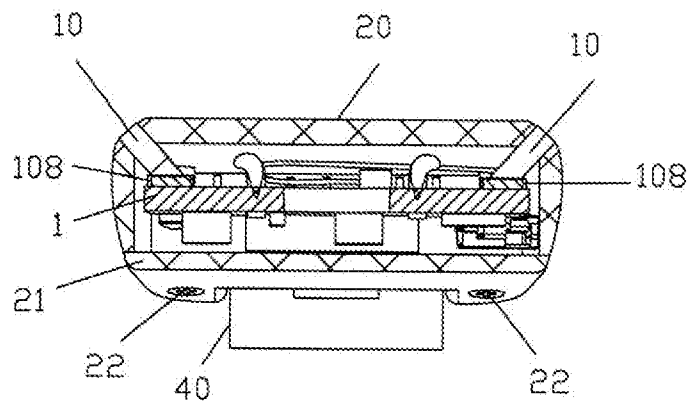
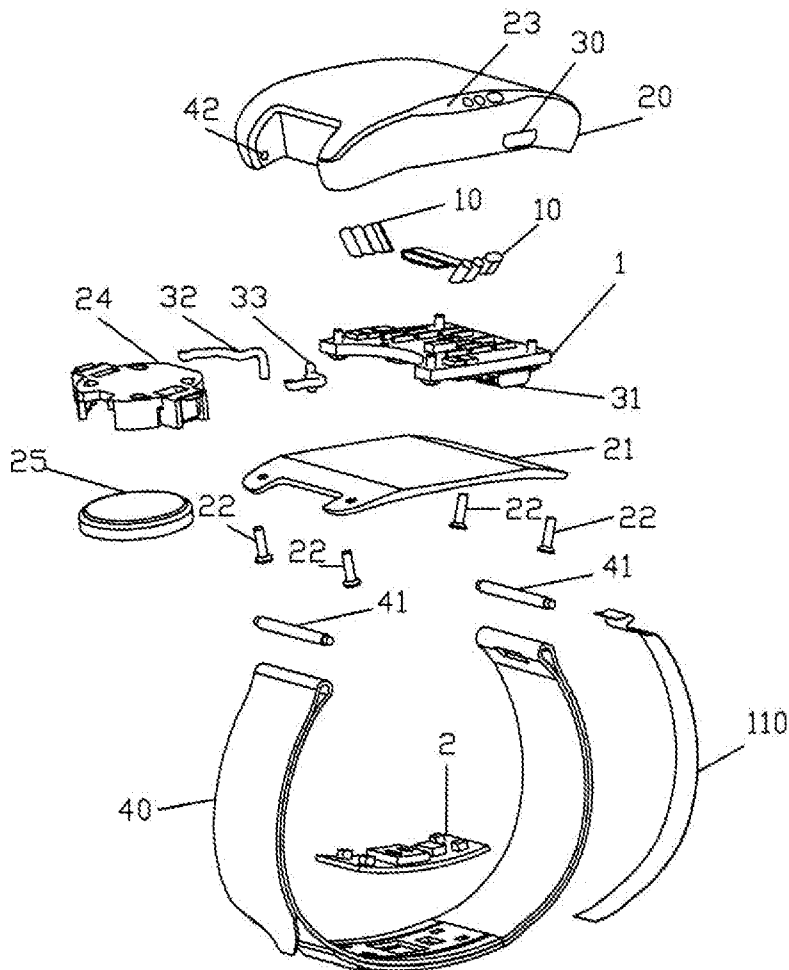
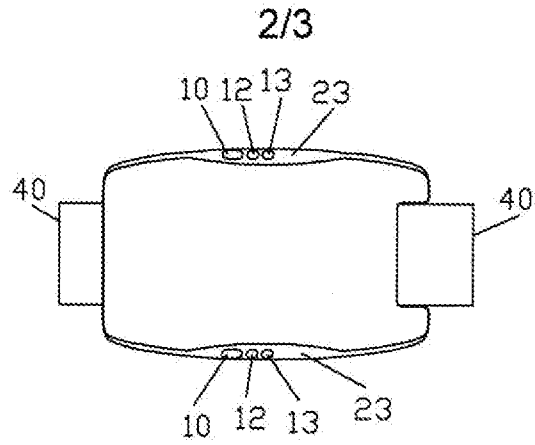


FIG 2



3/3

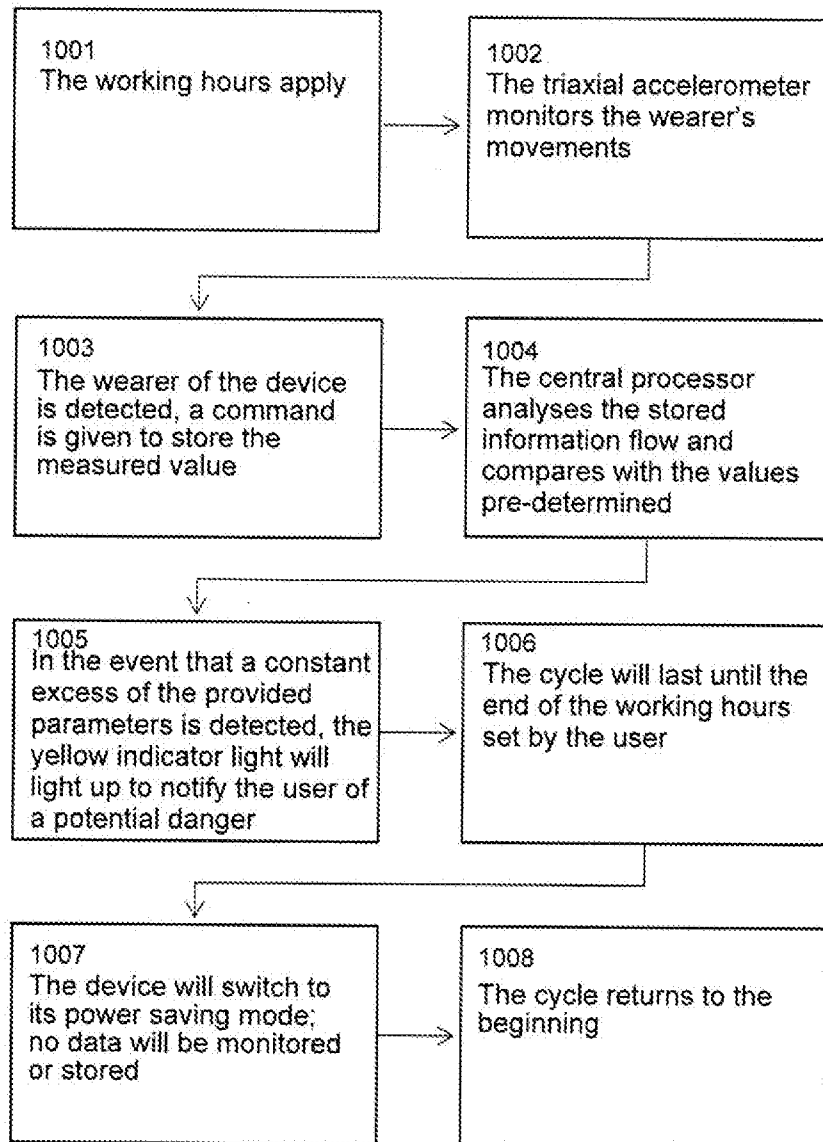


FIG 5

INTERNATIONAL SEARCH REPORT

International application No  
PCT/EE2017/000006

A. CLASSIFICATION OF SUBJECT MATTER  
INV. A61B5/024 A61B5/00  
ADD.  
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED  
Minimum documentation searched (classification system followed by classification symbols)  
A61B  
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2016/166153 A1 (WOO KEVIN [US] ET AL) 16 June 2016 (2016-06-16) the whole document	1-5
A	US 2013/289419 A1 (BEREZHNYY IGOR [NL] ET AL) 31 October 2013 (2013-10-31) abstract claims 1-12 figure 1	1-5
A	US 8 965 730 B2 (FITBIT INC [US]) 24 February 2015 (2015-02-24) abstract column 17, line 7 - column 20, line 58 column 41, line 10 - column 43, line 11	1-5

Further documents are listed in the continuation of Box C.  See patent family annex.

\* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance	"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"E" earlier application or patent but published on or after the international filing date	"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
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"O" document referring to an oral disclosure, use, exhibition or other means	"&" document member of the same patent family
"P" document published prior to the international filing date but later than the priority date claimed	

Date of the actual completion of the international search 13 December 2017	Date of mailing of the international search report 20/12/2017
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Name and mailing address of the ISA/ European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Authorized officer Marteau, Frédéric
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# INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No PCT/EE2017/000006
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专利名称(译)	评估办公室工作人员活动和工作环境风险因素的装置		
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申请号	EP2017783712	申请日	2017-09-12
[标]发明人	KOTSAR GERT		
发明人	KOTSAR, GERT		
IPC分类号	A61B5/024 A61B5/00		
CPC分类号	A61B5/681 A61B5/00 A61B5/01 A61B5/024 A61B5/02416 A61B5/02438 A61B5/0245 A61B5/0531 A61B5/0533 A61B5/1118 A61B2503/20 A61B2503/22 A61B2560/0204 A61B2560/0242 A61B2560/0462 A61B2562/0219 A61B2562/0271 A61B2562/029		
优先权	U201600042 2016-09-16 EE		
外部链接	<a href="#">Espacenet</a>		

#### 摘要(译)

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