Abstract: A single-unit ECG and blood pressure device (1) for complete cardiac exercise stress tests, which is compact, battery-operated, capable of being attached to the body of a patient (6), communicating through wireless radio signals (8) with a computer (10) for online processing of the measurement data transmitted by the wireless communication unit (7). The device is equipped with a twelve-channel ECG patient cable (2) and with a blood pressure cuff (3) comprising a Korotkoff sensor (4) attachable to the arm of the patient (6). The device (1) is fastened to a waist-belt attachable to the waist of the patient (6) and comprises a noise-resistant short range RF wireless module (47) through which the device (1) is connected to a computer (10) being in a proximity of the device (1) for online processing the measurement data transmitted by the wireless communication unit (7).

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SINGLE-UNIT ECG AND BLOOD PRESSURE MEASURING DEVICE FOR
CARDIOLOGICAL STRESS TESTS

The invention relates to a single-unit ECG and blood pressure device for complete cardiological exercise stress tests. It is a compact, battery-operated device provided with electrodes capable of being attached to the body of a patient through cables, and with a blood pressure cuff comprising a Korotkoff sensor. The blood pressure cuff is attachable to arm of the patient.

The causes of cardiovascular diseases and the premature deaths resulting from them have been studied extensively in the medical field for decades. Several noninvasive testing methods exist in medical practice for the examination of the cardiovascular condition of patients. Among these, exercise testing with continuously monitored ECG and blood pressure under gradually increased physical workload is still one of the most frequently used methods.

The first deployment of cardiological exercise testing methods dates back to the 1940s when American physician Arthur Master published his simplified "master-two-step" method /see ref. 3 and 4 below/, which was later named after him. However, this method, which required the patient to move freely, made it cumbersome to maintain continuous and simultaneous ECG and blood pressure monitoring, which was to become a basic professional requirement in subsequent years. For this reason, several guidelines, of cardiology advised against Master's method / see ref. 5 /, privileging electronically controllable stress testing devices such as treadmills and ergometers, which could be employed with the patient being stationary, thereby making continuous and simultaneous monitoring more convenient.

There are detailed professional guidelines including requirements for the implementation of exercise stress testing and for the interpretation of its results /see ref. 1 and 2 below/. These guidelines emphasize the importance of simultaneous monitoring and assessing both ECG and blood pressure signals for the sake of the patient's full safety. Whenever we use the term "complete test" in the following, what we mean is a test which employs simultaneous ECG and blood pressure monitoring. These sources, in accordance with current professional practice, name two now widely-used devices: the treadmill and the ergometer. Determining the extent of achieved workload - computable as oxygen consumption equivalent MET value /see
ref. 1 / - is considered to be of prognostic significance regarding the patient being tested. MET values are used with conventional stress test devices, but they are virtually absent from methods such as the "master two step," which enable free movement. Since simultaneous monitoring during such exercises is not feasible, these methods nowadays are hardly ever employed.

Typical implementation of exercise tests involves fastening ECG electrodes to the patient's body, which are then connected to an ECG device. The patient's blood pressure signals are separately recorded by a blood pressure device, which is normally produced by a different manufacturer than the ECG device. In such arrangements, both devices are—rather inconveniently—placed several meters away from the patient. The two types of signal are transmitted to a PC-based computer unit to be synchronized and displayed. Widely-used as this arrangement is, it necessitates the use of several electronic cables and pneumatic tubes, which hinder the patient's free movement. During exercise stress tests, the considerable amount of workload often causes the patient to suffer different types of complications (occasionally even deaths might occur), which lead to the sudden termination of the test. In such cases, the patient will have to be properly attended to, which involves placing the patient on a chair or a bed, and sometimes the use of resuscitating devices. For this reason, to enable the patient's sufficient mobility as well as continuous and simultaneous monitoring is top priority in such critical cases /see ref. 6/. Nowadays, there are solutions where the ECG device is connected to the computer through wireless technology, but the blood-pressure device is still connected to the computer through cables as a separate unit, whereby the moving of the patient, when needed, remains cumbersome.

Mechanical vibrations, muscle tractions, and other disturbances greatly compromise the reliability of automatic blood pressure measurement. Automated auscultative blood pressure measurement technique using Korotkoff signals synchronized with ECG signals, known as R-wave gating method, has been well-known for a long time. The aforementioned disturbing factors are further aggravated by the problems of synchronization due to there being two separate devices mostly produced by two different manufacturers. As a consequence, several renowned experts have warned about the inaccuracies occurring in automatic blood pressure measurement during
exercise tests, which is why they recommend manual blood pressure measurement /see ref. 21.

Some technical arrangements have been known to utilize wireless transfer, for instance, in hospitals where electrocardiogram (ECG) data recorded at different places are to be transmitted to an in-house central database computer, as shown in US 3,986,498. In this particular arrangement, they employ a central aerial and each individual ward has a transmitter in it as well. The arrangement, however, is suitable only for patient monitoring, where data recorded/collected in different places have to be accumulated at a central venue for central surveillance.

US 4,121,573 also describes a remote cardiographic monitoring system and electrode, while US 4,216,779 and US 4,617,937 suggest ways of monitoring blood pressure measurement. US, 4,396,018 demonstrates a way to detect Korotkoff sounds. US, 4,408,614 also provides teaching about a particular way of this examination. US 4,889,132 describes a portable ambulatory blood pressure device and testing process. Nevertheless, none of these arrangements reflects on the possible ways in which an advantageous system could be constructed in compliance with professional standards through combining these elements and methods in cardiological exercise testing, which is suitable for continuous and simultaneous ECG and blood pressure monitoring even when the moving of the patient becomes necessary due to different types of health complications.

The principal object of the invention is to eliminate the disadvantages of the conventional arrangements delineated above by developing for cardiological exercise testing a small-size, battery-operated, single-unit ECG and blood pressure measuring device for complete stress test, which, fastened to the patient's body, takes advantage of wireless communication utilizing local short-range RF transmission for this purpose. This device is intended to enable the freedom of movement for the patient being tested as well as unhindered continuous monitoring during the test, even when it has to be interrupted. This is especially important in cases when the patient suffers complications which require immediate medical care. Our aim is to extend the scope of complete cardiological exercise testing methods to such formerly widely-used tests as "master two step" and intensive walking, to which we will apply professionally approved MET values. Since the single-unit combined ECG and blood pressure device is battery-operated, electric mains power related disturbances can be avoided. In
addition, it enhances the feasibility of the short-distance transmission of low voltage signals. Furthermore, said local short-range RF transmission, such as Bluetooth transmission, can effectively reduce the sensitivity to RF noises and to inter signal interchange derived from several electric wires, cords or cables. We can additionally introduce comparative and adaptive algorithms for manually and automatically recorded blood pressure measurements. As a consequence of these advantages, more accurate blood pressure measurement can be achieved.

The invention as described in the opening paragraph, in its most general embodiment is a device which is fastened to a waist-belt attachable to the waist of the patient and comprising a noise-resistive short range RF wireless module through which the device is connected to a computer being in a proximity of the device for online processing the measurement data transmitted by the wireless module (47).

The embodiments of the invention will be further described in details by referring to drawings as listed below:

Fig. 1 shows a patient prepared for cardiological exercise testing, with small-size, single-unit ECG and blood pressure device with related accessories fixed on his/her body.

Fig. 2 shows a wireless cardiological exercise testing system with a treadmill-based device, which enables complete testing by means of a single-unit ECG and blood pressure measuring device.

Fig. 3 shows a wireless cardiological exercise testing system with an ergometer-based device, which enables complete testing by means of a single-unit ECG and blood pressure measuring device.

Fig. 4 shows the main functional units of a single-unit ECG and blood pressure device and the way they are connected.

Fig. 5 shows the theoretical background of the improved version of R-gated auscultatic blood pressure measurement.

Fig. 6 shows a wireless cardiological exercise testing system extended to a "master two step"-based device, which enables complete testing by means of a single-unit ECG and blood pressure measuring device.

Fig. 7 shows a wireless cardiological exercise testing system, which controls the patient's movement using linearly arranged light-sources, which enables complete testing by means of a single-unit ECG and blood pressure measuring device.
Fig. 1 shows a patient 6 prepared for cardiological exercise testing, with a compact wireless-based, single-unit ECG and blood pressure device 1 fastened with a waist-belt 5 on his/her body. A twelve-channel ECG patient cable 2 and its standard connectors to electrodes R,L,F,N,C1,C2,C3,C4,C5,C6, a blood pressure cuff 3 with its pneumatic unit as well as a well known Korotkoff sensor 4 and its cables are connected to the battery-operated single-unit wireless ECG and blood pressure device 1 according to the present invention. The twelve-channel ECG patient cable 2 and its standard connectors to electrodes R,L,F,N,C1,C2,C3,C4,C5,C6 attached to patient's 6 body according to medical standards, are implemented with a short cable, enabling more accurate signal recording and avoiding picking up electric noises. In this case, what can be considered to be short is a cable less than 0.7 m in length. The cables of traditional ECG devices are far longer than this/ making it impossible to place the traditional device on the patient's body. The cables of the blood pressure cuff 3, its pneumatic units, and Korotkoff sensor 4, all attached to the patient's 6 body, are also short (less than 0.7 m in length), which enable more accurate signal recording, even with low voltage signals. The single-unit ECG and blood pressure device 1, as can be seen in the description of the invention, enables the synchronized and continuous analysis of the received ECG and blood pressure signals.

Fig. 2 shows a widely used treadmill-based cardiological exercise testing system where the wireless-based single-unit ECG and blood pressure device 1, the twelve-channel ECG patient cable 2 and its standard connectors to electrodes R,L,F,N,C1,C2,C3,C4,C5,C6, the blood pressure cuff 3 with its pneumatic unit as well as Korotkoff sensor 4 and its cables are attached to the patient's 6 body. The patient 6 is positioned on the running surface 15 of a treadmill 14, which is initially stationary. The treadmill 14 is connected to a computer 10. The device 1 is fastened to a waist-belt 5 attachable to waist of the patient 6. It comprises an internal noise-resistive short range RF wireless communication module 47. The computer 10 is preferably equipped with a monitor 11, a keyboard 12, and a mouse 13. The computer 10 in case that no internal feature built in, further provided with an external wireless communication unit 7 is connected to the computer 10 through an USB port. The medical staff performing the test registers the patient's 6 personal details and selects the stress protocol of suitable intensity by using the keyboard 12 and the mouse 13. After the commencement of the test the computer 10 controls the speed
and angle of the running surface 15 of the treadmill 14 according to a selected protocol. The patient 6, in keeping with the given position of the running surface 15, is exposed to a gradually increasing amount of workload. During the test, the ECG and blood pressure signals recorded by the single-unit wireless device 1 are transmitted to the computer 10 for storage and analysis. The transmission (reception by computer 10) takes place by means of an optionally USB-connected wireless communication unit 7, which operates through short-range RF signals 8. The signals and the results obtained from the analysis are then displayed in accordance with professional standards on the monitor 11. We can thereby trace how the patient's cardiovascular system responds to an increasing amount of workload. The limits of the measured and calculated parameters are regulated by professional medical guidelines, on the basis of which the system sends warning signs to the operating staff when these limits are exceeded, or it can even stop increasing the workload. Should the patient 6 require instant medical care during the complete test, continuous and safe ECG and blood pressure monitoring is still feasible as a result of our wireless, single-unit arrangement, even when the patient has to be moved.

In a preferred embodiment of the invention the noise-resistive short range RF wireless module 47 of the device 1 is capable of transmitting data into a computer 10 being in the proximity of less than 10 m distance of the device 1. This remote computer 10 has to be, of course, provided with an appropriate built-in or external RF receiver 7 and a communication software for receiving the RF signals sent by the short range RF wireless module 47 of the device 1.

Fig. 3 represents a widely used ergometer-based cardiological exercise testing system where the wireless-based single-unit ECG and blood pressure device 1, the twelve-channel ECG patient cable 2 and its standard connectors to electrodes R,L,F,N,C1,C2,C3,C4,C5,C6, the blood pressure cuff 3 with its pneumatic unit as well as the Korotkoff sensor 4 and its cables are attached to the patient's body. The patient 6 does not initially operate the stationary winch 17 of the ergometer 16. The ergometer 16 is connected to the computer 10. The computer 10 is equipped with a monitor 1, a keyboard 12, and a mouse 13. The wireless communication unit 7 is connected to the computer 10 through an USB port. The medical staff performing the test registers the patient's personal details and selects the stress protocol of suitable intensity by using the keyboard 12 and the mouse 13. After the commencement
of the test the computer 10 controls the increasing amount of workload on the winch 17 of the ergometer 16 according to the selected protocol. Following the guiding signals of the ergometer 16, the patient 6 evenly drives the wheel with the winch 17, which gradually increases the workload. During the test, the ECG and blood pressure signals recorded by the single-unit wireless device 1 are transmitted to the computer 10 for storage and analysis. The transmission takes place by means of a USB-connected wireless communication unit 7, which operates through short-range RF signals 8. The signals and the results obtained from the analysis are then displayed in accordance with professional standards on the monitor 11. We can thereby trace how the patient's cardiovascular system responds to an increasing amount of workload. The limits of the measured and calculated parameters are regulated by professional guidelines, on the basis of which the system sends warning signs to the operating staff when these limits are exceeded, or it can even stop increasing the workload. Should the patient 6 require instant medical care during the complete test, continuous and safe ECG and blood pressure monitoring is still feasible as a result of our wireless, single-unit arrangement, even when the patient has to be moved.

Fig. 4 shows the block-diagram of a single-unit wireless ECG and blood pressure device 1 according to the present invention. The twelve-channel 2 ECG patient cable and its standard connections to respective electrodes R,L,F,N,C1,C2,C3,C4, C5,C6 are hooked up to an A/D converter 45 through a twelve-channel ECG amplifier 44. The Korotkoff sensor 4 and its cable are also connected to the A/D converter 45 through a Korotkoff signal detector. The blood pressure cuff 3 and its pneumatic unit are also connected to the A/D converter 45 through a pressure detector 42. At the same time, the blood pressure cuff 3 and its pneumatic unit are hooked up to a processor and memory unit 46. The processor and the memory unit 46 is connected to the A/D converter 45 and to the wireless module 47. The functional units of the single-unit wireless ECG and blood pressure device 1 are powered by a battery-operated supply unit 48. The electronic signals of the twelve-channel ECG patient cable 2 and its standard connections to electrodes R,L,F,N,C1,C2,C3,C4,C5,C6 are transmitted, through the twelve-channel ECG amplifier 44, to the A/D converter 45, which digitalizes the analogue signals. These signals, by means of the processor and memory unit 46, can be further transmitted to other wireless devices through the wireless module 47. The wireless module 47 is capable of receiving commands - for
example to start blood pressure measurement - from other external units. Being de-
coded by the processor and memory unit 46, it is the pressure controlling unit 41 that
executes the command by increasing the pressure in the blood pressure cuff 3 and
its pneumatic unit to the required value and then decompressing it in a linear fashion
by means of the pressure controlling unit 41, constantly relying on the values meas-
ured by the pressure detector 42. In the meantime, the electronic signal transmitted
through the cable of the Korotkoff sensor 4 to the Korotkoff signal detector 43 is con-
tinuously analyzed. The signal is digitalized by the A/D converter 45, which sends it
under the control of the processor and memory unit 46 through the wireless module
47 to the computer 10 for further processing and evaluation.

Fig. 5 shows - in its sub-figures 5A, 5B, 5C - the theoretical background of the
improved embodiment of R-gated auscultatic blood pressure measurement used in
exercise stress testing. Fig. 5A depicts a typical stress test graph 50, where the hori-
zontal axis represents the time period of the test. The left-hand side vertical axis
shows the number of heart-beats per minute (bpm), the changes in blood pressure
(mmHg), and the extent of the workload (Watt). The right-hand side vertical axis dis-
plays the standardized MET value of the intensity of the achieved workload. The
properly targeted application of the invented device 1 enables the calculation of the
MET values. This part of Fig. 5A shows the changes in heart rate 54, the value of the
actual amount of the workload 53, and the intermittently measured blood pressure
values 55. Figure 5B represents a full cycle 51 of blood pressure measurement,
where the horizontal axis represents the time, the left-hand vertical axis shows the
cuff pressure 56, and the right-hand vertical axis displays the relative Korotkoff sig-
als. Figure 5C shows a given time segment 52 of the full cycle 51 of blood pressure
measurement, where one can see the ECG signal 57 serving to synchronize the cuff
pressure 56, the gate 58 synchronized with the ECG and the Korotkoff signals
measured in it, and the systolic and diastolic values 60. The integrated typical stress
test graph 50 depicts eight blood pressure values represented by vertical line seg-
ments. We demonstrate the applied method through the seventh segment. The full
cycle 51 of blood pressure measurement pertains to the measurement of the seventh
blood pressure value, where it is demonstrated that the cuff pressure of the blood
pressure device is increased in a period of 15 seconds so that it exceeds the systolic
value, then the pressure is gradually and linearly decreased in a period of 15-45 sec-
onds. We examine the Korotkoff signals 59 which fall within the 58 gate synchronized with the ECG, which is adapted to the ECG signal 57. The Korotkoff signals 59 falling outside the gate are regarded as noise. In order to set the appropriate cuff pressure value, we draw upon the previously measured blood pressure value, and the Korotkoff signals which already occur and then disappear during the initial period of inflation (0-15 sec). Unlike in most currently used methods, the determination of the blood pressure value takes place not in a target computer, for all basic data are fed into the evaluating unit of a high-performance central PC. This arrangement enables the correction of a large number of manually measured blood pressure values (considered to be valid in exercise stress testing at the moment), as well as automatically determined values through intelligent adaptive algorithms, which are well-known of themselves. This highly improves the ability to determine systolic and diastolic values 60.

Fig. 6 shows the extension of the complete wireless cardiological exercise stress test arrangement to a well-known but now rarely used "Master Two Step" exercise testing system, where the wireless-based single-unit ECG and blood pressure 1 device is attached to the 6 patient's body. The twelve-channel ECG patient cable 2 and its standard connectors to electrodes R,L,F,N,C1,C2,C3,C4, C5,C6, the blood pressure cuff 3 with its pneumatic unit as well as the Korotkoff sensor 4 and its cables are also represented in Fig. 6. The patient 6 is positioned standing in front of the "Master Two Step" walking steps 20 waiting for the test to start. The "Master Two Step" walking steps 20 is connected to the computer 10. The computer 10 is equipped with a monitor 11, a keyboard 12, and a mouse 13. The wireless communication unit is connected to the computer 10 through an USB port. The medical staff performing the test registers the patient's 6 personal details and selects the stress protocol of suitable intensity, also presentable in MET equivalent values, by using the keyboard 12 and the mouse 13. After the commencement of the test, the computer 10 through the connected controlling unit 21 controls the signal-lamps 22,23,24,25,26 flashing one after the other, placed on the surface of the walking steps 20, with gradually increasing speed in accordance with the protocol selected. Reaching the end of the steps, a double sound signal warns the patient to turn around and proceed on the steps in the opposite direction following the flashing signal-lamps 26,25,24,23,22 placed on the surface of the walking steps 20 and turn around again at the end of the steps. The patient 6 is exposed to a gradually increasing amount of
workload, as he/she is following the signal-lamps 22,23,24,25,26 placed on the surface of the walking steps 20 flashing one after the other with increasing speed. During the test, the ECG and blood pressure signals recorded by the single-unit wireless device 1 are transmitted to the computer 10 for storage and analysis. The transmission takes place by means of a USB-connected wireless communication unit, which operates through short-range RF signals 8. The signals and the results obtain from the analysis are then displayed in accordance with professional standards on the monitor 11. We can thereby trace how the patient's 6 cardiovascular system responds to an increasing amount of workload. The limits of the measured and calculated parameters are regulated by professional guidelines. When these limits are exceeded the system sends warning signs to the operating staff or it can even stop increasing the workload. Should the patient 6 require instant medical care during the complete test, continuous and safe ECG and blood pressure monitoring is still feasible as a result of our wireless, single-unit arrangement, even when the patient has to be moved. In case of the "Master Two Step" testing system, it is through our invention that the disadvantages of the system can be obviated and thereby it can be reintroduced to the market.

Fig. 7 shows the wireless cardiological exercise stress test arrangement as implemented through a movement controlling linearly arranged set of lights, where the wireless-based single-unit ECG and blood pressure device 1, the twelve-channel ECG patient cable 2 and its standard connectors to electrodes R,L,F,N,C1,C2,C3, C4,C5,C6, the blood pressure cuff 3 with its pneumatic unit as well as Korotkoff sensor 4 and its cables are attached to the patient's 6 body. The patient 6 is positioned standing in front of the signal-lamp 30 waiting for the test to start. The housing of signal-lamp 32 which also contains the controlling module is connected to the computer 10. The computer 10 is equipped with a monitor 11, a keyboard 12, and a mouse 13. The wireless communication unit is connected to the computer 10 through an USB port. The medical staff performing the test registers the patient's 6 personal details and selects the stress protocol of suitable intensity, also presentable in MET equivalent values, by using the keyboard 12 and the mouse 13. After the commencement of the test, the computer 10 through the connected controlling unit controls, by means of the signal-lamps 30,31,32,33,34 placed preferably at equal distances from each other. The lamps flash one after the other with gradually increasing speed in accor-
dance with the protocol selected. At the last signal-lamp in the line, a double sound signal warns the patient to turn around and proceed in the opposite direction following the flashing signal-lamps 34,33,32,31,30 and turn around again at the last lamp. The patient 6 following the signal-lamps 30,31,32,33,34 on the floor, flashing one after the other with increasing speed, is exposed to a gradually increasing amount of workload. During the test, the ECG and blood pressure signals recorded by the single-unit wireless device 1 are transmitted to the computer 10 for storage and analysis. The transmission takes place by means of an wireless communication module 47 and an possibly USB connected wireless communication unit 7, which operates through short-range RF signals 8. The signals and the results obtain from the analysis are then displayed in accordance with professional standards on the monitor 11. We can thereby trace how the patient's 6 cardiovascular system responds to an increasing amount of workload. The limits of the measured and calculated parameters are regulated by professional guidelines. When these limits are exceeded the system sends warning signs to the operating staff or it can even stop increasing the workload. Should the patient 6 require instant medical care during the complete test, continuous and safe ECG and blood pressure monitoring is still feasible as a result of our wireless, single-unit arrangement, even when the patient has to be moved.

In sum, on the basis of Fig.1-7 we can establish that using the present invention in complete ECG and blood pressure exercise tests we can eliminate:

- cables which limit the patient's freedom of movement and compromise continuous monitoring as well as immediate medical care in case of health complications which require the patient to be moved,

- disturbances in the transmission and synchronization of electronic signals which are required for precise blood pressure measurement.

The examples above relate to some characteristic examples of the embodiments of the invention which most frequently appear in medical practice. The present invention, however, is not restricted to these embodiments, but it can be used in any stress test arrangements due to its advantages.
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6. Reasons for terminating an exercise test provide independent prognostic information: 2014 apparently healthy men followed for 26 years
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CLAIMS

1. A single-unit ECG and blood pressure device (1) for complete cardiological exercise stress tests, which is a compact, battery-operated device (1) provided with electrodes (R,L,F,N,C1,C2,C3,C4,C5,C6) capable of being attached to the body of a patient (6) through cables, and with a blood pressure cuff (3) comprising a Korotkoff sensor (4) attachable to arm of the patient (6), characterized in that the device (1) is fastened to a waist-belt (5) attachable to waist of the patient (6) and that it comprises a noise-resistive short range RF wireless module (47) connecting the device (1) through an external wireless communication unit (7) to a computer (10) being in a proximity of the device (1) for online processing the measurement data transmitted by the wireless module (47).

2. The device according to Claim 1, characterized in that the device (1) comprises a twelve-channel ECG patient cable (2) of less than 0.7 meter length between standard patient connectors on the single-unit device (1) and the corresponding electrodes (R,L,F,N,C1,C2,C3,C4,C5,C6) attachable to the body of the patient (6).

3. The device according to Claim 1, characterized in that the blood pressure cuff (3) comprising a Korotkoff sensor (4) has a cable of less than 0.7 meter length between the blood pressure cuff (3), and the radio communication unit of the single-unit device (1).

4. The device according to Claim 1, characterized in that the device (1) is adapted to being used together with ergometer- and treadmill-based testing devices.

5. The device according to Claim 1, characterized in that the device (1) is adapted to being used together with "Master Two Step" simple walking steps (20) and indicating the intensity of the workload in MET equivalent values.

6. The device according to Claim 1, characterized in that the device (1) is adapted to intensive movement controlling simple signal-lamps (30-34) and indicating the intensity of the workload in MET equivalent values.
7. The device according to Claim 1, characterized in that the device (1) comprises direct signal synchronization to the computer (10).

8. The device according to Claim 1, characterized in that the noise-resistant short range RF wireless communication unit of the device (1) is capable for transmission data into a computer (10) being in the proximity of less than 10 m of the device (1).
INTERNATIONAL SEARCH REPORT

A. CLASSIFICATION OF SUBJECT MATTER
INV. A61B5/00 A61B5/0404 A61B5/0225
ADD.

According to International Patent Classification (IPC) or 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 practical, search terms used)
EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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

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