(54) Title: A DEVICE AND A COMPUTERIZED METHOD ARRANGED TO ENABLE A HEALTH-RELATED COACHING OF AN INDIVIDUAL.

(57) Abstract: The device (1), according to the invention is arranged to enable a health-related coaching. The device (1) comprises a central processing unit (8) arranged to collect and to process signals from the monitoring means (2). The monitoring means (2) comprise a sensor (4) arranged to provide a signal representative of a physiological condition of the individual being monitored to the central processing unit (8). The monitoring means (2) comprises a data preprocessing means (6) arranged to carry-out a preprocessing of the raw measurement signal. Preferably, the preprocessing means (6) is arranged to provide condensed, interpreted information to the data processing means. Still preferably, the preprocessing means are integrated with corresponding sensor (4). The central processor (8) comprises data processing means (8a) arranged for determining a reference health profile of said individual based on the measurement signal. In order to enable a regular update of the reference health profile the data processing means (8a) comprises a logical unit (8d) arranged to enable said update. The device (1) further comprises storage means, for example a memory unit, arranged for storing a plurality of health-related events (10a) in a database of a computer (10), said health-related events being described by a plurality of valid conditions (10b), stored in a look-up table. The data analysis means (8b) of the device (1) is arranged to analyze the reference health profile in order to determine an actual condition of the individual and to evaluate a likelihood of occurrence of the health-related events based on a comparison between the actual condition and the valid conditions (10b). The data analysis means (8b) is further arranged to actuate the informing means (8c) to produce a suitable message to the individual. The message is feedback to the individual by means of an user interface (12). In case of an acute medical emergency the device (1) is arranged to communicate to a remotely arranged unit (14) for enabling a suitable medical assistance.
Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IT, LU, MC, NL, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published: — with international search report

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A device and a computerized method arranged to enable a health-related coaching of an individual.

The invention relates to a device arranged to enable a health-related coaching of an individual, said device comprising monitoring means arranged to monitor a vital sign of the individual by means of a sensor arranged for measuring a signal representative of said sign.

The invention further relates to a computerized method for enabling a health-related coaching said method comprising the step of monitoring a vital sign of an individual by means of a sensor arranged for collecting data related to said sign.

A monitoring system arranged to monitor a vital sign of the individual is known from US 5,544,661. The known system comprises an expert module arranged to determine whether a predefined parameter in the vital sign exceeds a preset threshold. The known system is arranged to automatically contact a remote medical assistance center upon detection of an event that the parameter exceeded said threshold. The known system further comprises communication means arranged to enable a communication between a medical specialist located at the remote medical assistance center and the individual being monitored. Upon establishing the communication by means of a two-way voice channel, the clinician can forward messages to the individual related to a current health condition of the individual. It is a general practice, known to the person skilled in the art that the messages forwarded by the medical specialist can comprise recommendations on a suitable medication and/or other instructions with regard to therapeutic or other measures to be taken by the individual in accordance to his health condition.

It is a disadvantage of the known system that in order to produce a suitable messaging and/or coaching of the individual an interaction with a remotely arranged unit is required. This necessity may be a limiting factor for a success in time-critical circumstances. For non-acute circumstances the necessity to interact with the remotely arranged unit can be a burden to the individual and cause unnecessary irritation to him due to bills from both, the telephony company and the consulting medical specialist.
It is an object of the invention to provide a device arranged for generating health-related coaching messages to the individual.

To this end the device according to the invention comprises monitoring means further arranged to forward said signal to a central processing unit, said central processing unit comprising:

- the data processing means arranged for determining a reference health profile of said individual based on said signal;
- storage means arranged for storing a plurality of health-related events in a database of a computer, said health-related events being described by a plurality of valid conditions;
- data analysis means arranged to analyze said reference health profile in order to determine an actual condition and to evaluate a likelihood of occurrence of the health-related events based on a comparison between the actual condition and the valid conditions;
- informing means arranged to generate a message to the individual based on said evaluation;
- said device further comprising user interface arranged to feedback said message to the individual.

The technical measure of the invention is based on the insight that it is currently difficult to ensure continuous medical supervision of patients outside of hospitals and nursing homes. Such a continuous supervision is particularly advantageous in emergency situations as well as in general health care or in the fitness domain. Cardiac diseases and specific medical emergency events like Sudden Cardiac Arrest (SCA), Atrial Fibrillation (AF), Myocardial Infarction (MI) can hardly be detected by non-continuous or one-time measurement like a 24-hour measurement by means of a Holter ECG. Regular measurements, for example at every visit to the doctor or even on a daily basis are also not sufficiently reliable for this purpose. A time span between an event and a first treatment is usually critical for the success of a therapy in these cases.

In order to enable a fast response for emergencies, the detection of a health-related event, analysis of the patient's condition, classification of his condition followed by an informing the individual about measures to be taken to reduce the consequences of said condition have to be provided by an automatic system which is preferably used at all times. The device according to the invention enables these steps by providing the data processing means arranged for determining a reference health profile of the individual based on the
measured signal. An example of the reference health profile is a data record of patient-related data, comprising the data on the vital signs being monitored, like ECG, as well as other data, for example weight, gender, height, cholesterol level, blood sugar level, etc. Next, the device according to the invention comprises storage means arranged for storing a plurality of health-related events in a database of a computer, said health-related events being described by a plurality of valid conditions. An example of a condition is SCA, MI or AF described by a threshold value of a vital sign. Alternatively, a condition can be described by a combination of running values of the vital signs which altogether can lead to a harmful effect. For example, a combination of an increased temperature, low blood sugar level and an increased heart-rate during an exercise may lead to a potentially harmful effect. Still alternatively, a combination of an increased weight, decreased physical activity and increased cholesterol level can also be harmful, however not in an acute way. The storage means can be arranged to store the conditions, for example in a functional relation to the signals representing the vital signs, or using any other suitable alpha-numerical representation.

The device according to the invention further comprises data analysis means arranged to analyze said reference health profile in order to determine an actual condition of the individual and to evaluate a likelihood of occurrence of the health-related events based on the comparison between the actual condition and the valid condition. In case the data analysis means detects that the likelihood of the occurrence of the health-related effect is not negligible, the informing means is actuated in order to generate a message to the individual about the results of said comparison. The thus generated message comprises the feedback to the individual by means of a suitable interface, for example an audio or visual signal, a textual message on a display, a tactile signal, or by means of any other suitable signaling means. The message can be implemented as a simple signaling, using a color code, or a tone.

Alternatively, the message can comprise recommendations, ranging from coaching instructions, like ‘reduce your pace’ to a general recommendation in terms of a diet, sports or life style. Also, the message can comprise an instruction, for example, to apply a defibrillation shock for an acute actual condition of the individual.

In an embodiment of the device according to the invention, the data processing means comprise a logical unit arranged to enable an update of the reference health profile. In order to enable an accurate messaging to the individual it is preferable that a dynamics in the health condition of the individual is being recorded by the device. For this purpose the reference health states is subjected to regular updates. It is understood that for different conditions of the individual the update has to be initiated on a time-specific moment. The
logical unit of the device according to the invention is arranged to select a suitable period for updating the reference health profile. Preferably, the logical unit comprises means to determine the frequency of the update, for example a logic circuit arranged to trigger the update of the reference health profile upon a result of a suitable analysis. An example of the suitable analysis is a check of a logical condition whether a signal from a vital sign sensors represents a resting phase measurement. Alternatively, the suitable analysis can be enabled by an analysis of a trend in the vital sign signals. For signals representing a stable state of an individual's vital sign, the frequency of the update can be decreased. For signals with a high fluctuation in a running value, like blood pressure, for example, the frequency of the update is set to a high value, for example to a number of times per day. In order to enable this analysis the storage means are preferably arranged to store preceding values of the signals from the sensors and to make them available to the logic circuit.

In an embodiment of the device according to the invention the monitoring means comprise a plurality of sensors arranged to provide a plurality of signals representative of a plurality of vital signs being monitored, the logical unit being further arranged to select a valid sensor from said plurality of sensors based on a predefined criterion, the data processing means being arranged to use a valid signal from said valid sensor for updating the reference health profile.

It is found to be advantageous to provide the device with the plurality of sensors so that a plurality of vital signs can be monitored. The sensors can be arranged to monitor the corresponding vital signs in a continuous mode, or on demand, being arranged to be actutable by the central processing unit of the device. It is of particular importance to update the reference health profile, meeting the dynamics of the health condition of the individual, especially when monitoring sportsmen or rehabilitating patients. In order to yield an accurate reference health profile, the logical unit is arranged to select the valid sensor for purposes of such update, the valid sensor being defined as a sensor yielding an unperturbed measurement. An unperturbed measurement is defined as a rest signal. For example for ECG it is a resting period of the individual, preferably during sleep, for blood sugar level it is a measurement at early hours upon an empty stomach, for the body weight it can be a daily measurement at corresponding times, preferably before breakfast.

In a further embodiment of the device according to the invention the data processing means is further arranged to detect a pre-defined parameter in the signal, the informing means being arranged to generate the message comprising a specific instruction related to said parameter.
For purposes of anticipating a medical emergency it is advantageous to deduce a parameter in the signal, for example to determine a heart-rate from an ECG measurement. In case the heart-rate corresponds to a pre-determined value, like an abnormally increased heart rate or an abnormally decreased heart-rate, the message is forwarded to the individual reflecting this abnormality. Preferably, the calculation of said parameter is carried-out by means of a suitable calculation algorithm available in the device. Examples of suitable calculation algorithms comprise an algorithm for detecting a Sudden Cardiac Arrest, an algorithm for calculating personal allowable limits for the heart-rate during an exercise, an algorithm for calculating a current condition of the individual, etc. Preferably, an outcome of said calculation is made available to the individual be means of the user interface.

In a still further embodiment of the device according to the invention the device further comprises communication means arranged to enable a communication to a remotely arranged unit by means of a telephony interface.

It is found to be advantageous to provide the information about the monitoring results by means of providing the measured signal to a clinician or a coach for purposes of a further inspection, diagnosis and the like. This feature is of particular importance for individuals which are currently in a rehabilitation phase from a medical emergency as it may reduce a number of their visits to the hospital, thus increasing a quality of their life.

The computerized method according to the invention comprises the steps of:

- providing the individual with the data processing means, said means being arranged for determining a reference health profile of said individual based on said data;
- storing a plurality of health-related events in a database of a computer, said health-related events being described by a plurality of valid conditions;
- providing the individual with a data analysis means, arranged to analyze said reference health profile in order to determine an actual condition and to evaluate a likelihood of occurrence of the health-related events based on a comparison between the actual condition and the valid conditions;
- providing the individual with a feedback medium for forwarding a message to the individual based on said evaluation.

These and other aspects of the invention will be discussed in more detail with reference to Figures.
Fig. 1 presents a schematic view of an embodiment of architecture of the device according to the invention.

Fig. 2 presents a schematic view of an embodiment of an operational flow-chart of the device according to the invention.

Fig. 3 presents an embodiment of the device according to the invention.

Fig. 4 presents an embodiment of a user interface according to the invention.

Fig. 1 presents a schematic view of an embodiment of architecture of the device according to the invention. The device comprises a central processing unit 8 arranged to collect and to process signals from the monitoring means 2. The monitoring means 2 comprise a sensor 4 arranged to provide a signal representative of a physiological condition of the individual being monitored to the central processing unit 8. It is also possible that the monitoring means 2 comprise a plurality of sensors 4a arranged to monitor a plurality of vital signs and to provide a plurality of signals to the central processing unit 8. For cardiac of fitness applications, the sensor 4 is preferably arranged to monitor the electrocardiogram (ECG) or a respiration rate of the individual. The sensors 4a are preferably arranged to monitor a body parameter, like weight, blood cholesterol level, user contextual data, like physical activity, environmental data, like air temperature, humidity, etc. The sensors can be arranged as simple measurement device with an analog or a digital mode of operation, providing a raw measured signal to the data processing means 8a. In an alternative arrangement, the monitoring means 2 comprises a data preprocessing means 6 arranged to carry-out a preprocessing of the raw measurement signal. This feature is advantageous as it limits a volume of the data to be transmitted between the modules of the device 1. Preferably, the preprocessing means 6 is arranged to provide condensed, interpreted information to the data processing means. Still preferably, the preprocessing means are integrated with corresponding sensors 4, 4a. The sensors can be implanted on the body of the individual, directly worn on or attached to the body. Alternatively, the sensors can be integrated into a body wear or into a separate portable module, which can then be attached to a clothing of the individual or to his body part. Sensors 4, 4a can further be arranged as deniable sensor, for example an ECG-sensor integrated into a clothing peace, which is not worn by the individual permanently. Alternatively, said sensors can be arranged as ambient sensors, for example a wall-mounted sensor. This type of sensor is preferable for environmental sensors. Still alternatively, the sensors can be arranged to require an interaction with the individual, for
example a weighting scale, or a blood cuff. Still further, the sensors 4, 4a can be arranged to provide a continuous measurement of the signal or they can be arranged to be actuated by the central processor 8 to take a measurement.

The central processor 8 comprises data processing means 8a arranged for determining a reference health profile of said individual based on the measurement signal. In a first embodiment of device 1 the reference health profile is determined by the data processing means 8a using the signal from a single sensor 4, for example in case the device 1 is arranged to monitor a sole health-related condition, for example a blood sugar level. Alternatively, for more complex applications, the reference health profile is determined based on a plurality of signals from a plurality of corresponding sensors 4, 4a. In order to enable a regular update of the reference health profile the data processing means 8a comprises a logical unit 8d arranged to select a valid sensor from the plurality of sensors 4, 4a in order to enable said update. For example, in case the reference health profile is determined using an ECG data, a blood sugar level, a reading from an activity sensor and a reading from an environment sensor, the logical unit is arranged to read a signal from any of the above sensors, when said signal represents a certain state of the individual, for example a resting phase. This reading is then used to update the reference health profile. Preferably, the logical unit comprises means to determine the frequency of the update, for example a logic circuit 8e arranged to trigger the update of the reference health profile upon a result of a suitable analysis. An example of the suitable analysis is a check of a logical condition whether a signal from a vital sign sensor represents a resting phase measurement. Alternatively, the suitable analysis can be enabled by an analysis of a trend in the vital sign signals. For signals representing a stable state of the individual, the frequency of the update can be decreased. For signals with a high fluctuation in a running value, like blood pressure, for example, the frequency of the update is set to a high value, or example a to number of times per day. In order to enable this analysis the storage means 10 are arranged to store preceding values of the signals from the sensors and to make them available to the logic circuit 8e.

The device 1 further comprises storage means, for example a memory unit, arranged for storing a plurality of health-related events 10a in a database of a computer 10, said health-related events being described by a plurality of valid conditions 10b, preferably stored in a look-up table (not shown). In order to enable an accurate coaching of the individual it is important to provide a plurality of health-related events to the device 1, which are then used by the device for comparison with an actual condition of the user. An example of the health-related event is a condition of over exercising, characterized, for example by an
increased heart rate or an increased muscle strain. Another example of the health-related event is a decreased overall fitness condition, characterized, for example by a decreased physical activity and/or an increase of the individual’s weight. Still another example of the health-related event is a decrease of a vascular condition of the individual, characterized, for example by an increase of the blood cholesterol level and/or an increased blood pressure. It is also possible that a health-related event is positively defined, for example as an improvement in a physiological condition related to a monitored vital sign. For example, for sportsmen or rehabilitating patients the health-related event can be defined by means of corresponding thresholds in the monitored vital signs.

The data analysis means 8b of the device 1 is arranged to analyze the reference health profile in order to determine an actual condition of the individual and to evaluate a likelihood of occurrence of the health-related events based on a comparison between the actual condition and the valid conditions. For this purpose the data analysis means 8b is preferably arranged to carry-out a decision step in order to decide which of the signals is important for determining the actual condition of the individual. Furtheron, the data analysis means can be arranged to run a calculation algorithm in order to detect a predefined parameter in the signals from the sensors 4, 4a. An example of the predefined parameter is a heart-rate. Preferably the database 10 comprises a list 10d of the predetermined parameters together with their allowable ranges 10e, as well as corresponding calculation algorithms 10c for said parameters. In case the data analysis means 8b determines that any of the predefined parameters is out of the allowable range, it actuates the informing means 8c to produce a message to the individual. Preferably, the informing means 8c is arranged to run a script generator, which can generate customized messages to the individual based on his actual condition. Script generators are known per se in the art and their functioning will not be elaborated here in detail. In a simple embodiment of the device 1, the informing means are arranged to actuate a suitable means of the user interface, for example a light panel or an acoustic means. The functioning of the user interface will be described in more detail with reference to Fig. 4.

When the message to the individual is generated, it is made available to the individual by means of the user interface 12. The user interface 12 can comprise, for example, semaphoring means 12a, where the actual condition of the used is being color-coded. For example, for a good actual condition, a green light can be lit, whereas for a harmful or potentially harmful condition a red light can be switched on. In order to attract the attention of the user, an on/off frequency of the corresponding lights of the semaphore can be
modulated, for example for not-acute cases the light can be lit constantly and for acute cases the frequency of the on/off switching can be set to 10 Hz. Alternatively, the user interface 12 comprises a display 12b arranged to feedback the messages (not shown) generated by the informing means 8c. The messages can range from a simple instructions for non-acute cases to specific instructions for cases of an acute medical emergency. For example, for an non-acute case for an individual doing sports, the message can read ‘Reduce your pace’, or ‘exercise lighter’. For an acute medical emergency, for example for an SCA, the message can comprise instructions on how to apply a defibrillating shock. Preferably, the user interface 12 is arranged as a wristwatch-like unit.

The device 1 can further be arranged to comprise a telephony unit in order to enable a communication to a remotely arranged medical assistance center 14. This feature enables a remotely located medical specialist to ensure that the messaging has occurred in due time and that the messages are correctly formulated in medical terms. The remotely arranged unit 14, for example a call center is preferably arranged with a user interface capable of receiving data from the device 1 over the communication line.

Preferably, the device 1 is arranged as a modular unit, which meets the personal requirements of virtually any user. The various modules of the device 1 are connected over a number of communication links providing a Body Area Network. Some of the communication links can be wired, others may comprise a wireless communication line.

Preferably, the wireless communication comprises a Bluetooth or DECT communication protocol. The resulting communication network comprises at least all modules of the device 1, which are worn on the body of the individual or are carried by him. Additionally, the devices, which are not worn or carried by the individual, like a weighting scale, may still be a part of the Body Area Network. The data from such a device is collected by the central processing unit 8 by means of a suitable wireless communication.

Fig. 2 presents a schematic view of an embodiment of a flow-chart of an operation of the device according to the invention. An operational cycle 20 of the device according to the invention can be divided into two phases: a pre-exercise functioning and a functioning during the exercise, these parts being schematically represented in the Figure by letters P and E, respectively. During a pre-exercise phase P the reference health profile of the individual is being updated at step 22 by selecting a valid sensor, which provides unperturbed signals. The update can be made by means of a monitoring system, as is explained with reference to Fig. 1. Additionally, for determining an accurate reference health-profile, some other patient-related data can be input to the system using a user interface, said data
comprising for example a blood glucose level, a body weight. In the exercise phase E during
the step 24 the monitoring means collect all relevant data on vital signs of the individual and
forward them to the data processing means. At step 26 the data processing means carry-out
necessary calculations to yield a new reference health profile corresponding to a certain
physical activity based on the data provided by the monitoring means. The new reference
health profile may use the data of the reference health profile in order to establish the actual
condition of the individual. For example, in order to evaluate the likelihood of occurrence of
a heart-attack, the heart-rate during rest can be used. The calculated new reference health
profile is forwarded to the data analysis means at step 28, where the actual condition of the
individual is established. The data analysis means performs a trend analysis in the reference
health profile at step 30 and compares the actual condition to the pre-stored valid conditions
related to a plurality of health-related events. In case no potential harm may be caused to the
individual (step 31), the individual receives a feed-back at step 33 that a continuation of the
exercise is allowed. Upon a termination of the exercise, at step 35, the exercise results are
stored in the storage means of the device and can be used for updating allowable limits of the
personal reference health profile. Alternatively, in case a potentially harmful health-related
effect may occur (step 32), the informing means are actuated at step 34 which deliver a
suitable message to the individual comprising a specific instruction indicating a reason for
said message. For example, in case the data analysis means detect a negative trend in the
health profile, a source of the vital sign causing this negative trend is indicated. For example,
a message ‘heart beat too high, reduce your pace, see you diet specialist’ can be delivered, in
case a previous measurement showed an increase in the body weight of the individual and the
ECG sensor during exercise fell outside allowable limits and/or did not correlate with a
breathing rate. Alternatively, a message ‘reduce your pace’ can indicate that the heart beat is
too high and no further health-related parameters changed with respect to a previous
computation. Still alternatively, in case the actual condition of an acute type is detected, the
individual and/or others are immediately informed about his condition and the
recommendations how to reduce harmful consequences of said condition are given. For
example, in case the individual is suffering from an SCA, a message to apply a defibrillator is
triggered.

After a suitable message was delivered to the patient, the device goes to step
36 where the comparison between the actual condition and the pre-stored valid conditions is
being checked again. In case the negative trend has stopped, a message to continue the
exercise is sent to the individual (step 33), otherwise, a new suitable message is sent to the
individual at step 37, for example ‘Stop exercising’. In case an acute health-related event was detected, a message to a remote medical assistance center is sent at step 38, preferably together with respective data related to a vital sign causing said acute event.

Fig. 3 presents an embodiment of the device according to the invention. The embodiment of the device 40 is particularly suited to enable a cardiac coaching of an individual I. The device 40 comprises a plurality of body-worn sensors, for example a heart-rate sensor 42, an acceleration sensor 44, a respiration rate sensor 46. It must be understood that a body-worn sensor means a sensor which is attached to the body, is implanted in the body of the individual or is integrated into a body wear of the individual. A principle to fabricate such sensors is known to a person skilled in the art. Preferably, the body-worn sensors are arranged to communicate via corresponding wireless links, for example Bluetooth, DECT (schematically shown by corresponding arrows 48) to a control system 51 of the device comprising the central processing unit, as is set forth with reference to Fig. 1. The control system 51 comprises data processing means, storage means, data analysis means, informing means (all not shown), the functioning thereof is discussed with reference to Fig. 1. The control system is arranged to analyze the corresponding signals from the sensors, to generate a reference health profile of the individual, to calculate a trend in the reference health profile and to actuate the user interface 50 (indicated by an arrow 47) in order to enable a suitable feedback to the individual with a necessary coaching. Feedback can comprise exercise tips, like a duration and a type of exercise, a recommendation to visit a doctor or a general recommendation on a lifestyle, like a suitable type of nutrition. In case the individual is suffering from an acute medical condition, the control system 51 actuates the communication means (arrow 49), for example a mobile telephone unit 52 in order to enable a connection to a remotely arranged medical care unit. The user interface 50 is arranged to feedback the coaching messages generated by the informing means (not shown) of the control system 51 to the user. Preferably, the user interface is integrated in a wristwatch-like device. The user interface 51 can be further arranged to enable a data input to the device by the individual. This feature can be enabled by providing an infrared communication link to a personal computer or an organizer, or, alternatively to arrange the user interface 50 with data input means. An example of a suitable data input means is a key panel. An embodiment of the user interface is discussed in further detail with reference to Fig. 4.

Fig. 4 presents an embodiment of a user interface according to the invention. The user interface 60 comprises a housing 62 and fixation means 64. Preferably, the user interface is a wristwatch-like device mountable on an arm of the individual. The fixation
means 64 preferably comprise a band with a suitable locking means. The housing 62 comprises a display 66, preferably operable in a color mode. The display 66 can comprise semaphoring means 67, comprising a number of colored lights 67a, 67b, 67c, for example light-emitting diodes. In a simple embodiment of the user interface the suitable messaging to the individual is enabled by means of the semaphoring means 67, a color-code of the semaphoring device representing a condition of the individual. In a more sophisticated embodiment, the display 66 comprises a textual screen 68, arranged to provide a textual messaging 68a, comprising coaching instructions and suitable recommendations to the individual. Additionally, the display 66 can comprise a further textual screen 69, for example for purposes of echoing the data input 69a by the individual to the device. The data input to the device is enabled by the data input means 74. The data input means 74 can be arranged to enable a communication to a computer, or any other electronic information carrier, for example by means of an infrared port, or any other suitable communication means. Alternatively, the data input means 74 can comprise a key panel with keys 74a to enable a manual alpha-numerical input. Still alternatively, the data input means 74 can comprise dedicated keys (not shown) to indicate a start/stop of the exercise to the device as well as to enable a request for a system information by the individual. Also a further key (not shown) can be provided to enable a request on the reference health profile, the results thereof being shown on the display 68. In order to enable a communication between the user interface 60 and other electronic components of the device, the housing 62 comprises communication means 70. The communication means comprise an internal communication means 70a, for example means to enable a wireless communication to the control system of the device (not shown). Alternatively, the communication means 70a can be arranged to enable the communication to the modules of the device (not shown) by means of a suitable wiring. The communication means 70 further comprises an external communication means 70b to enable a communication to a remotely arranged unit in case the individual is suffering from an acute condition. The external communication means 70b are preferably arranged to actuate a mobile telephony unit (not shown) of the individual. Alternatively, the external communication means 70b can be arranged to actuate a dedicated telephony unit, for example a home station arranged at the individual’s home, in order to establish a telephony communication to the remotely arranged medical assistance center. Upon an event the communication to the medical assistance center is established, the individual can receive instructions or other messages by means of a loudspeaker 73 and to react on them using a microphone 72. The microphone 72 can be further used to input information to the device by
voice. For that purpose the central processing unit of the device is arranged with a voice recognition engine (not shown). The loudspeaker 73 can be further used in the user interface 60 to generate local acoustic signals, like warnings or other suitable types of signaling to the individual.

Although embodiments of the device and the method according to the invention are illustrated in the accompanying drawings and described in the foregoing detailed description, it will be understood by those skilled in the relevant art that the invention is not limited to the embodiments disclosed, but is capable of numerous rearrangements, modifications and substitutions without departing the spirit of the invention as set forth and defined in the following claims.
CLAIMS:

1. A device (1) arranged to enable a health-related coaching of an individual (I), said device comprising monitoring means (2) arranged to monitor a vital sign of the individual by means of a sensor (4) arranged for measuring a signal representative of said sign, said monitoring means (2) being further arranged to forward said signal to a central processing unit (8), said central processing unit comprising:
   - the data processing means (8a) arranged for determining a reference health profile of said individual based on said signal;
   - storage means (10) arranged for storing a plurality of health-related events (10a) in a database of a computer, said health-related events being described by a plurality of valid conditions (10b);
   - data analysis means (8b) arranged to analyze said reference health profile in order to determine an actual condition and to evaluate a likelihood of occurrence of the health-related events based on a comparison between the actual condition and the valid conditions (10b);
   - informing means (8c) arranged to generate a message (67a, 67b, 67c, 68a) to the individual based on said evaluation;
   - said device further comprising user interface (12) arranged to feedback said message (67a, 67b, 67c, 68a) to the individual.

2. A device according to claim 1, wherein for the actual condition of an acute type the message comprises an instruction to reduce harmful consequences of said condition.

3. A device according to claim 1, wherein for the actual condition of a non-acute type, the message comprises a coaching instruction to the individual.

4. A device according to claim 1, wherein the monitoring means (2) comprise a data preprocessing means (6) arranged to carry-out a pre-processing of the signal, said preprocessing means being further arranged to make available said preprocessed signal to the data processing means (8a).
5. A device according to claim 1 or 4, wherein the data processing means (8a) comprise a logical unit (8d) arranged to enable an update of the reference health profile.

6. A device according to claim 5, wherein the logical unit (8d) comprises means to determine a frequency of the update of the reference health profile, said means being arranged to initiate said update in accordance with said frequency.

7. A device according to claim 6, wherein the monitoring means (2) comprise a plurality of sensors (4, 4a) arranged to provide a plurality of signals representative of a plurality of vital signs being monitored, the logical unit (8d) being further arranged to select a valid sensor from said plurality of sensors based on a predefined criterion, the data processing means being arranged to use a valid signal from said valid sensor for updating the reference health profile.

8. A device according to any one of the preceding claims, wherein the data processing means (8a) is further arranged to detect a pre-defined parameter (10d) in the signal, the informing means (8c) being arranged to generate the message (68a) comprising a specific instruction related to said parameter.

9. A device according to claim 8, wherein the data processing means (8a) is arranged to initiate a pre-stored algorithm (10c) arranged for calculating said parameter (10d).

10. A device according to claim 9, wherein the data processing means (8a) is arranged to actuate the informing means (8c) in order to enable a suitable messaging to the individual based on an outcome of said calculation.

11. A device according to claim 1, wherein said device (1) further comprises communication means (70) arranged to enable a communication (70b) to a remotely arranged unit (14) by means of a telephony interface.
12. A device according in claim 11, wherein the communication means (70) is arranged to forward the signal to the remotely arranged unit (14) for purposes of remote inspection.

13. A device according to claim 1, wherein the monitoring means (2), the central processing unit (8) and the user interface (12) are being packaged in separate modular units.

14. A computerized method for enabling a health-related coaching, said method comprising the steps of:

- monitoring a vital sign of an individual (1) by means of a sensor (4) arranged for collecting data related to said sign;

- providing the individual with the data processing means (8a), said means being arranged for determining a reference health profile of said individual based on said data;

- storing a plurality of health-related events (10a) in a database of a computer, said health-related events being described by a plurality of valid conditions (10b);

- providing the individual with a data analysis means (8b), arranged to analyze said reference health profile in order to determine an actual condition and to evaluate a likelihood of occurrence of the health-related events based on a comparison between the actual condition and the valid conditions;

- providing the individual with a feedback medium (12) for forwarding a message (67a, 67b, 67c, 68a) to the individual based on said evaluation.

15. A method according to claim 14, wherein for the actual condition of an acute type the message comprises an instruction to reduce harmful consequences of said condition.

16. A method according to claim 15, wherein for the actual condition of a non-acute type, the message comprises a coaching instruction to the individual.

17. A method according to claim 16, wherein said method further comprises the steps of:

- providing said individual with a plurality of sensors (4a) arranged for monitoring a plurality of vital signs by providing a plurality of data related to said signs,

- constructing the personal health profile using said plurality of data.
18. A method according to claim 17, wherein the method further comprises the step of: updating the reference health profile during a period of monitoring.

19. A method according to claim 18, wherein for updating the reference health profile, said method further comprises the steps of:
   - providing a logical unit (8d) arranged to select a valid sensor from said plurality of sensors based on a predefined criterion;
   - acquiring valid data from the valid sensor;
   - updating the reference health profile using said valid data.

20. A method according to claim 14, wherein the method further comprises the step of:
   - detecting a predefined parameter (10d) in the data;
   - messaging the individual with a specific instruction (68a) related to said parameter.

21. A method according to claim 20, wherein said method further comprises the steps of:
   - storing an allowable reference value (10e) of the parameter (10d) in the database;
   - comparing a running value of the parameter with the reference value of the parameter;
   - forwarding an alarm to a remotely arranged unit (14) upon an event the running value of the parameter exceeds the reference value.

22. A method according to claim 21, wherein said method further comprises the step of transmitting the data over a communication line to the remotely arranged unit (14) for a remote inspection.
### INTERNATIONAL SEARCH REPORT

#### A. CLASSIFICATION OF SUBJECT MATTER

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<th>IPC</th>
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<th>A61B5/04</th>
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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)
  - IPC 7 A61B G06F

- 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

<table>
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<tr>
<th>Category</th>
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<td>X</td>
<td>US 6 047 203 A (INMAN D MICHAEL ET AL) 4 April 2000 (2000-04-04) abstract; compounds 1-3 column 1, line 50 - column 3, paragraph 15 column 6, paragraph 24 - paragraph 50</td>
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Further documents are listed in the continuation of box C.

**Patent family members are listed in annex.**

**Special categories of cited documents:**
- **A** document defining the general state of the art which is not considered to be of particular relevance
- **E** earlier document but published on or after the international filing date
- **L** document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- **O** document referring to an oral disclosure, use, exhibition or other means
- **P** document published prior to the international filing date but later than the priority date claimed

**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**

**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**

**Document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.**

**Document member of the same patent family**

- **Date of the actual completion of the international search**
  - 20 October 2004

- **Date of mailing of the international search report**
  - 28/10/2004

**Name and mailing address of the ISA**
- European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk
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**Authorized officer**
- Gaillard, A
### Box II  Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This International Search Report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. **X** Claims Nos.:  14–22  
   because they relate to subject matter not required to be searched by this Authority, namely:  
   **Rule 39.1(iv) PCT - Diagnostic method practised on the human or animal body**

2.  
   Claims Nos.:  
   because they relate to parts of the International Application that do not comply with the prescribed requirements to such an extent that no meaningful International Search can be carried out, specifically:

3.  
   Claims Nos.:  
   because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

### Box III  Observations where unity of Invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

1.  
   As all required additional search fees were timely paid by the applicant, this International Search Report covers all searchable claims.

2.  
   As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.

3.  
   As only some of the required additional search fees were timely paid by the applicant, this International Search Report covers only those claims for which fees were paid, specifically claims Nos.:  

4.  
   No required additional search fees were timely paid by the applicant. Consequently, this International Search Report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:  

**Remark on Protest**  
- The additional search fees were accompanied by the applicant's protest.  
- No protest accompanied the payment of additional search fees.
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<td>JP 2002507131 T</td>
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