AUTOMATED PERSONAL EXERCISE REGIMEN TRACKING APPARATUS

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ABSTRACT

A computer implemented method and apparatus for automated personal rep-counting and exercise orchestration. A portable computing device is programmed to access a pre-planned exercise regimen for a user, who includes a series of differing exercise activity sets, each exercise activity set including a prescribed exercise repetition count for a prescribed exercise type. An exemplary embodiment monitors a user's progress through an exercise regimen by automatically counting exercise repetitions, instructing the user to progress to the next exercise activity set in the exercise regimen when a required repetition count is complete for a current exercise activity set. A sensor unit, typically in wireless communication with the portable computing device, is selectively attached to a user body part or a dynamic exercise equipment element thereby allowing the portable computing device to count of repetitions of the particular exercise activity. In some embodiments, the wireless sensor unit affixes magnetically for easy selective attachment.

Related U.S. Application Data

Continuation-in-part of application No. 11/618,858, filed on Dec. 31, 2006.

Provisional application No. 60/851,502, filed on Oct. 14, 2006, provisional application No. 60/872,817, filed on Dec. 4, 2006.
FIG 4
Total Reps = 10
Total Time = 17 seconds
Average Rate = 35 reps per minute
First-to-Last Deceleration = 78% rate reduction

FIG 6
Start

Couple Motion Sensor to Portable Computing Device

Receive User Exercise Regimen Selection

Retrieve Selected Exercise Regimen from Datstore

Output (Prompt) Exercise Activity Set/Type to User

Attach Motion Sensor to Exercise Apparatus

Start Exercise Activity Set

Receive Time Dependent Motion Signals from Sensor

Determine Repetition Events from the Motion Signals

Determine rep count from the Repetition Events

Store Exercise Performance Data in datastore Indexed with the Exercise Activity

Prompt User for Exercise Expiring Rest Period, Next or Deferred Exercise Activity Set

Graphically Output Performance Data/Metrics

Completed Exercise Activity Set, Rep Rates, Relative Power, Change Rates

End
Exercise Regimen 1100

Exercise Activity Set 1 1102
  Type 1104
    Reps 1106

Exercise Activity Set 2 1108
  Type 1110
    Reps 1112

Exercise Activity Set N 1114
  Type 1116
    Reps 1118

FIG 11
AUTOMATED PERSONAL EXERCISE REGIMEN TRACKING APPARATUS

CROSS-REFERENCE TO RELATED APPLICATIONS


[0003] This application is also related to applicants’ co-pending U.S. patent application Ser. No. 11/461,375 filed Jul. 31, 2006 entitled “Intelligent Pace Setting Portable Media Player” and U.S. provisional patent application 60/817,553 filed on Jun. 28, 2006. All of the aforementioned patent applications are hereby incorporated by reference in their entirety as if fully set forth herein.

RELEVANT INVENTIVE FIELD

[0004] The various exemplary embodiments disclosed herein relate generally to a portable computing device, such as a personal digital assistant, cellular telephone or portable media player and more specifically to a portable computing that is interfaced with a sensor and configured to monitor and orchestrate repetitive exercise.

BACKGROUND

[0005] It has become a very common activity for a wide range of individuals to go to a gym and exercise using a variety of exercise equipment, including free weights and universal gym machines. Because people often use a wide variety of exercise machines, it is often difficult for a user to keep track of how many repetitions the user has performed during a current or previous exercise activity set. Furthermore, users often have a planned exercise regimen that they perform when going to the gym. For most users, the planned exercise regimen is written on paper or simply remembered. Either way, it is often an effort to keep track of their progress through a planned exercise regimen during their time in a gym. For users who use a written exercise regimen, they often write down performance statistics during or after completing their exercise.

[0006] This logging effort is time consuming and often not convenient when focused on doing exercise activities. In addition, the ability of a user to document performance is limited. The user generally is limited to documenting the number of repetitions completed of various exercise activities, but does not have a means of clearly evaluating or documenting the level of performance achieved in repetitive exercise motions. What is therefore needed is an automated system for moderating exercise across a wide range of equipment in a gym setting, assessing performance, and documenting completion.

SUMMARY

[0007] The various exemplary embodiments disclosed herein address the needs in the relevant art. The user typically counts each repetition mentally to his or herself as he or she proceeds through the exercise activity set, thereby attempting to keep track of his or her progress through the set. At the completion of the exercise activity set, the user may rest before performing the next exercise activity set, either with the same weights or with different weights, or goes on to a different exercise in the preplanned exercise regimen. Thus, by counting completed reps and keeping track of completed sets, a user progresses through a preplanned exercise regimen.

[0008] The full exercise regimen may include a wide variety of repetitive exercises, each exercise comprising a number of exercise activity sets for each muscle group. Thus, a user must keep track of his or her progress through each exercise activity set, by counting repetitions, as well as keep track of his or her progress through the overall exercise regimen. Additionally, a user may track performance metrics with respect to each exercise activity set to confirm progress toward a particular goal. Generally, performance tracking is performed mentally or manually using a paper log.

[0009] In an exemplary embodiment, an automated exercise regimen apparatus is generally encompassed as a portable computing device connected by wireless link to a wireless sensor unit, the wireless sensor unit comprising: a sensor operatively coupled to a processor, the sensor producing signals indicative of a dynamic event involving a repetitive exercise activity, the processor being programmed to process the signals produced by the sensor; and a wireless transceiver operatively coupled to the processor for transmitting the sensor signals to the separate portable computing device running rep-counting routines and an automated exercise regimen application, the separate portable computing device may be configured to monitor, count, store, orchestrate and report the number of physical repetitions performed by a user when engaged in a repetitive exercise activity set as well as to monitor progress through a preplanned exercise regimen and prompt the user when a next exercise activity is required of the regimen.

[0010] The portable computing device for orchestrating an exercise regimen comprises a processor, a display coupled to the processor for visually outputting exercise information to a user, a user interface coupled to the processor for receiving the user’s selection of one of a plurality of predefined stationary exercise regimens to be performed, a motion sensor coupled to the processor for receiving time dependent motion data from a sensor in communication with a dynamic element of an exercise apparatus, a computer readable storage medium comprising a datastore coupled to the processor having stored programmatic instructions. The programmatic instructions which when executed by the processor, causes the processor to output a prescribed exercise instruction corresponding to at least a portion of the selected exercise regimen, receive the time dependent motion signals from the sensor, determine a repetition event from the received motion data, determine a cumulative
repetition count from the repetition event and record the repetition count in the datastore.

BRIEF DESCRIPTION OF DRAWINGS

[0011] The features and advantages of the various exemplary embodiments will become apparent from the following detailed description when considered in conjunction with the accompanying drawings. Where possible, the same reference numerals and characters are used to denote like features, elements, components or portions of an exemplary embodiment.

[0012] FIG. 1—depicts a generalized block diagram of a portable computing device.

[0013] FIG. 1A—depicts a first exemplary embodiment of an intelligent wireless sensor unit.

[0014] FIG. 2—depicts an alternate exemplary embodiment of the wireless sensor unit in a housing which includes a magnetic component for affixing to a repetitively movable piece of exercise equipment.

[0015] FIG. 3A—depicts a time varying profile of accelerometer data collected from a sensor unit affixed to a dumbbell during a curl exercise.

[0016] FIG. 3B—depicts a time varying profile of accelerometer data collected from a sensor unit affixed to a weight during a bench press exercise.

[0017] FIG. 4—depicts an exemplary display upon the screen of a portable computing device, the example display showing a current exercise activity set to be performed by a user as required of a stored exercise regimen, as well as current count and timing information.

[0018] FIG. 5—depicts an exemplary display of the portable computing device, the display showing a graph of an exercise activity set that has just been performed by a user, the graph depicting reps vs. time, the profile representing a performance metric.

[0019] FIG. 6—depicts an exemplary display of the portable computing device, the display showing a graph of an exercise activity set that has just been performed by a user, the graph depicting reps vs. time, the profile representing a performance metric.

[0020] FIGS. 7A, 7B—depict another alternate exemplary display of exercise performance information in which two sets of an exercise activity set are presented side-by-side, each of the exercise activity sets graphed as reps vs. time and each being provided with select exercise performance statistics.

[0021] FIG. 8—depicts another exemplary display of exercise performance information, the alternate example display depicting exercise activity set graphed as a power curve, the power curve indicating the relative power output for each rep of an exercise activity set.

[0022] FIG. 9A—depicts a user engaged in a repetitive exercise activity set using a free weight bench press.

[0023] FIG. 9B—depicts a user beginning a repetitive exercise activity set using a universal equipment style bench press.

[0024] FIG. 9C—depicts a user completing a repetitive exercise activity set using the universal equipment style bench press.

[0025] FIG. 9D—depicts a user engaged in a repetitive exercise activity set involving inclined sit ups.

[0026] FIG. 10—depicts a process flow chart for the various exemplary embodiments disclosed herein.

[0027] FIG. 11—depicts an exemplary exercise regimen data structure.

DETAILED DESCRIPTION

[0028] A large variety of exercise activities involve a user performing stationary repetitive motions, such as weight lifting or calisthenics, in which a user performs a sequence of repetitive motions of the same or similar form to target a specific muscle groups. Such stationary exercise activities are generally differentiated by exercise activity sets and exercise types, for example, weight-lifting exercises such as bench presses, leg lifts, arm curls, and shoulder presses. The term “stationary,” as used herein defines an exercise activity set in which the user maintains a generally common physical location as opposed to a running exercise in which the user’s physical location varies over time. Such exercise activities may also include calisthenic exercise types, such as push-ups, sit-ups, and chin-ups which are designed to develop muscular tone and promote physical fitness for the targeted muscle group. Each completed repetitive motion exercise activity is commonly referred to as a repetition or simply a “rep.” A single rep generally involves the raising and lowering of weights within certain spatial limits.

[0029] Similarly, a single rep of a push-up exercise activity generally involves raising and lowering the user’s own body within certain spatial limits. Users generally perform a target number of repetitions of a particular exercise activity set while mentally counting each repetition. The target number of repetitions of an exercise activity is commonly referred to as a “set.” A single set of a repetitive weight lifting exercise may involve a user performing the lifting and lowering of a target weight in a repetitive manner without pausing or resting between reps for a predetermined number of times or until the user senses muscle exhaustion.

[0030] Users may also tailor their exercise regimen to achieve specific goals. For example, some users have a goal of building muscle mass, in which case a low number of repetitions per set are performed using weights near the users’ maximum capacity.

[0031] Alternately, some users may be interested in toning muscles or losing weight, in which case they generally perform a higher number of repetitions per set using lighter weights. Therefore, a preplanned exercise regimen may include a variety of exercises activities, each exercise activity having a predefined number of sets (i.e., exercise activity sets) and each set having a predefined number of repetitions at a particular weight or equipment setting to achieve each user’s personal goals. To effectively track progress toward a user’s goal, the user typically records each completed exercise activity set using a paper log, relying on the user to accurately record the number of sets and repetitions performed and the weights and/or exercise equipment settings used. However, the time to perform each exercise activity set is largely overlooked and typically goes unrecorded. In addition, even if a user employed a portable computing device to store the basic repetition count data for each of his or her completed sets, for example in a spreadsheet, the process using current technology would require manual data entry and would take as much time, if not more, than writing the data in a paper log.

[0032] The various exemplary embodiments disclosed herein address these limitations by providing the user with an automated exercise regimen apparatus that orchestrates a user’s progress through a predefined exercise regimen by
prompting the user as to which exercise activity set is currently required by a particular exercise regimen and by automatically counting and recording the number of time dependent repetitive motions (i.e., repetitive events) performed by the user, thereby determining his or her progress through and completion of a current exercise activity set in the exercise regimen. In this way, a portable computing device may be programmed to automatically monitor, count, store, orchestrate and report the exercise repetitions performed by a user. Where necessary, programs, algorithms and routines may be programmed in a high level language object oriented language, for example, Java™ C++, C/H, C, CORBA, PERL, AWK, Visual Basic™ or low level assembly language.

Hardware Overview

Referring to FIG. 1, a generalized block diagram of a portable computing device 100C is depicted. The portable computing device 100C may take a variety of forms, including a personal digital assistant (PDA), a smart cellular telephone, or a portable media player. In an exemplary embodiment, the portable computing device 100C may be configured to perform the automated exercise regimen orchestration while also playing music files to the user.

The portable computing device 100C includes a communications infrastructure 90 used to transfer data, memory addresses where data files are to be found and control signals among the various components and subsystems associated with the portable computing device 100C. A processor 5 is provided to interpret and execute logical instructions stored in the memory 10. The processor 5 may be a general purpose complex instruction set (CISC) type or a reduced instruction set computer (RISC) type. The memory 10 is the primary general purpose storage area for instructions and data to be processed by the processor 5. The term “memory” is used in its broadest sense and includes RAM, EEPROM and ROM. A timing circuit 15 is provided to coordinate activities within the portable computing device 100C in near real time and to generate timing values such as repetition event interval times, exercise interval times, and rest interval times. The processor 5, memory 10 and timing circuit 15 are directly operatively coupled to the communications infrastructure 90.

A display interface 20 is provided to drive a display 25 associated with the portable computing device 100C. The display interface 20 is operatively coupled to the communications infrastructure 90 and provides signals to the display 25 for visually outputting both graphical displays and alphanumeric characters. The display interface 20 may include a dedicated graphics processor and memory to support the displaying of graphics intensive media. The display 25 may be of any type (e.g., cathode ray tube, gas plasma) but in most circumstances will usually be a solid state device such as liquid crystal display (LCD) and/or a combination of light emitting diodes (LED.).

In an exemplary embodiment, the display 25 may be configured as a head-mounted display 25. In this exemplary embodiment, the display 25 provides exercise regimen information, exercise repetition counting information, performance information and/or graphing information upon a semi-transparent screen such that a user may view the real physical world through the screen while simultaneously viewing rep-counting information overlaid upon and/or around the user’s view of the real physical world. For example, the current rep-count may be displayed as a small overlaid graphic upon the user’s direct view of the real physical world.

A secondary memory subsystem 30 is provided which maintains stored exercise data, exercise regimen programmatic instructions, device setting and other data. In some exemplary embodiments, the exercise regimen is a data file that lists a sequence of required exercise activities, each of the exercise activities including an exercise type, an exercise qualifier, and a required quantity of repetitions of the exercise.

Optional retrievable storage units such as a hard disc drive 35, logical media storage drive 40 and an optional removable storage unit 45. One skilled in the art will appreciate that the hard drive 35 may be replaced with flash memory. The removable storage unit 45 may be used to update programs and data with new release versions. The secondary memory 30 may also be used for the storage of media files, such as musical media files, for embodiments that perform both exercise regimen orchestration and musical media play functionality. The secondary memory 30 is also used to store one or more exercise regimens which are selected by the user. The memory 10 and secondary memory 30 are all forms of computer readable storage media for storing programs and data used in the various exemplary embodiments described herein. The term “datastore,” may be used generically to refer to the computer readable storage media or information stored therein.

An internal power source 50 such as a battery and/or photocell supplies electrical energy to operate the electrical circuits included in the portable computing device 100C. A communications interface 55 is provided which allows for standardized electrical connection of peripheral devices to the communications infrastructure 90 including, serial, parallel, USB, and Firewire™ connectivity. For example, a user interface 60 and a transceiver 65 are operatively coupled to the communications infrastructure 90 via the communications interface 55. For purposes of this specification, the term user interface 60 includes the hardware and operating software by which a user interacts with the portable computing device 100C and the means by which the portable computing device 100C conveys information to the user and may include certain interactions with the display interface 20 and display 25.

The transceiver 65 facilitates the remote exchange of data and synchronizing of signals between the portable computing device 100C and a remote sensor unit 100P (FIG. 1A.) The transceiver 65 may also be used to communicate with other computing devices, for example a remote server or desktop computer from which exercise regimen information may be downloaded and/or exercise performance data may be stored.

In an exemplary embodiment, the transceiver 65 is envisioned to be of a radio frequency type normally associated with computer networks for example, wireless computer networks based on BlueTooth™ or the various IEEE standards 802.11x, where x denotes the various present and evolving wireless computing standards, for example WiMax 802.16 and WRANG 802.22. Alternatively, digital cellular communications formats compatible with for example GSM, 3G, CDMA, TDMA and evolving cellular communications standards. Both peer-to-peer (P2P) and client-server models are envisioned for implementation of an exemplary embodiment. In a third alternative embodiment,
the transceiver 65 may include hybrids of computer communications standards. An antenna 85 is provided to transmit and receive radio frequency radiation. The antenna 85 may be configured as an internal wire loop, a fixed length external antenna (e.g., “rubber ducky”) or telescoping whip antenna.

[0042] In another exemplary embodiment, the transceiver 65 is configured as an RFID transceiver (scanner) for accessing an RFID chip encompassed in the sensor unit 100P and/or affixed to or associated with a piece of exercise equipment. In this embodiment, the transceiver 65 transmits phase, pulse or frequency modulated signals, which if in sufficient proximity to the transceiver 65, energizes the RFID chip 100P causing the chip to transmit with an identification code colloquially known as a “barking bar code.” The identification code is then received by the transceiver 65. In some exemplary embodiments, the RFID data that is received by the portable computing device 100C when in certain proximity of a piece of exercise equipment identifies the type of piece of exercise equipment that the user is currently within proximity of and may be used to automatically select an appropriate exercise activity set or exercise regimen from the secondary memory 30.

[0043] In some exemplary embodiments, the RFID transceiver 65 may also be configured to program an RFID chip, causing data to be transmitted to the chip and stored within it. Such embodiments may be used, for example, to enable a portable computing device 100C to selectively program an RFID enabled wireless sensor unit 100P with, for example, the number of times the user has used the particular exercise equipment in which the RFID chip is associated. The variations in transponded RF signal strengths from the RFID chip could, for example, be used to determine when a motion event is occurring or has occurred.

[0044] The user interface 60 employed on the portable computing device 100C may include a pointing device (not shown) such as a mouse, thumbwheel or track ball, an optional touch screen (not shown); one or more push-button switches 60A, 60B one or more sliding or circular potentiometer controls (not shown), one or more voice recognition units (not shown) and one or more other type switches (not shown.) The user interface 60 provides input signals to the processor 5 that may be used to interpret user interactions with the portable computing device 100C. Various embodiments of an exemplary embodiment may incorporate portions of the user interface 60 with the display interface 20 and display 25. One skilled in the art will appreciate that the user interface devices which are not shown are well known and understood.

[0045] An optional sensor interface 70 may be provided to allow the incorporation of a motion sensor 75. For example, an accelerometer or an RFID scanner (not shown.) An internally installed motion sensor 75 may be used in conjunction with or in lieu of an external motion sensor 75P (FIG. 1A). The sensor interface may include an analog to digital converter circuit which periodically samples analog signals generated by analog types of motion sensors 75. Conversion to a digital motion event may then performed by the portable computing device 100C or wireless sensor 100P.

[0046] An audio subsystem 80 is provided and operatively coupled to the communications infrastructure 90. The audio subsystem 80 provides for the output of sounds corresponding to rep-counting feedback exercise regimen feedback, voice output reciting the current repetition count, other repetition counting statistics, exercise activity set or exercise type prompts, rest prompts, repetition speed prompts, repetition performance assessments, sound effects, rep-counting related audible phrases, exercise activity set prompting phrases, encouragement phrases, and/or exercise completion phrases. Output of the sound effects could be programmed to correspond with a user’s physical motion imparted with a piece of exercise equipment. For example, as a weight is lifted and lowered, a sound effect may be played that emulates the sound of pumping, sawing, hammering, and/or otherwise emulating a physical activity that conveys strength and power. In some exemplary embodiments, the pitch and/or volume of the sound effect may be varied with the detected physical motion of the exercise equipment, for example with the magnitude of the detected motion event of the exercise equipment.

[0047] In another exemplary embodiment, the audio output includes a voice emulation or voice synthesizer circuit which is configured to announce the next exercise activity set and/or type to be performed by the user, for example “Next up, Bench Press, 50 pounds, 12 reps.” In another exemplary embodiment, the audio output includes a verbal indication if a previous repetition was faster or slower than a predefined repetition time or speed threshold, for example “slow down” or “speed up” or “too fast” or “too slow.”

[0048] The audio subsystem includes a speaker output 95 and/or a headphone jack. Connection of a set of headphones 95 includes both traditional cable and wireless arrangements such as BlueTooth™ which are known in the relevant art.

[0049] The portable computing device 100C is envisioned to be encompassed within a highly portable housing 200C such as a palm-sized case or smaller form factor which may be held or worn by the user analogous to the various designs of, for example, the compact and highly portable Apple iPod™. In addition, the portable computing device 100C need not be a specialized piece of hardware, but may employ commercially available handheld devices such as a PDA or a suitably equipped cellular telephone. The portable computing device 100C is also envisioned to be built into a wrist-watcch and worn like a watch on the user’s wrist during exercise or incorporated in a set headphones and/or suitably equipped ear glasses.

[0050] The portable computing device 100C includes an operating system or operating environment, the hardware and software drivers necessary to fully utilize the devices operatively coupled to the communications infrastructure 90, and programmatic instructions operatively loaded into the memory 10 to perform rep-counting and exercise regimen orchestration in conjunction with the user’s interactions with user interface 60 and data received from the sensor unit 100P via the transceiver 65. Additional programmatic instructions may be provided to perform data logging where the data collected from the sensor unit 100P may be stored in the secondary memory 30 for future analysis, replay, or downloading to other computers. This collected data could also be used for training purposes. The portable computing device is programmed to at least execute the process shown in FIG. 10.

[0051] FIG. 1A provides a generalized block diagram of an embodiment of a wireless sensor unit 100P encompassed within a wireless sensor unit casing 200P. One skilled in the art will appreciate that many of the components, circuits, interfaces and devices are equivalent to those described for
the portable computing device 100C. In certain instances, abbreviated descriptions are provided to avoid duplicity and to simplify the understanding of this exemplary embodiment. For example, the wireless sensor unit 100P may be configured from an application specific integrated circuit (ASIC) or computer on a chip arrangements.

[0052] In this exemplary embodiment, the wireless sensor unit 100P includes a communications infrastructure 90P, a processor 5P, a memory 10P and a timing circuit 15P. The processor 5P, memory 10P, timing circuit 15P and communications infrastructure 90P may be integrated into a common chip for space and electrical power savings as well as improved ruggedness. The processor 5P has executable instructions to process sensor signals 75P received from a sensor interface 70P and transmit the processed sensor signals via an internal transceiver 65P to a portable computing device 100C. An optional display interface 20P may be provided to drive an optional display 25P, although in general this is not needed since a display is generally provided with the portable computing device 100C.

[0053] Where applicable, the processor 5P may further be programmed to perform re-counting in conjunction with input signals received from a user interface 60P via simple push button switches 60A, 60B and output information to a user on the display 25P. An optional secondary memory 30P may be provided in exemplary embodiments where data storage and greater programming flexibility are desirable. For example, where the wireless sensor unit 100P is performing time integration functions and/or processing multiple sensor inputs, a secondary memory 30P may be necessary to avoid overflowing the primary memory 10P. In such exemplary embodiments, exercise data may be buffered locally in wireless unit 100P before being sent to portable computer 100C.

[0054] Depending on the embodiment, an internal power source 45P such as a battery, and/or photovoltaic cells provides electrical energy to operate the electrical circuits included in this embodiment of the wireless sensor unit 100P. In some exemplary embodiments, an inertial power generation system may be employed within the wireless sensor unit 100P to generate power in response to the physical motions induced upon it by a user.

[0055] A communications interface 55P is provided which optionally provides for direct electrical connection of the wireless sensor unit 100P to the portable computing device 100C or another computer system. A simplified user interface 60P and a transceiver 65P operatively coupled to the communications infrastructure 90P via the communications interface 55P.

[0056] The transceiver 65P facilitates the exchange of data between the wireless sensor unit 100P and one or more portable computing devices 100C. The transceiver 65P is of a type compatible with the transceiver 65 for the portable computing device 100C. An internal antenna 85P is provided to transmit and receive radio frequency radiation in conjunction with the one or more portable computing devices 100C.

[0057] In another exemplary embodiment, the transceiver 65P is actually a low power device with little or no data receiving capability. In such an exemplary embodiment, the wireless sensor unit 100P acts simply as a remote transponder. For example, RFID technology may be used to enable such a low power embodiment as is known to those skilled in the art.

[0058] A sensor interface 70P is provided which allows one or more sensors 75P to be operatively coupled to the communications infrastructure 90P. The sensor interface 70P may monitor interactions with the user interface 60P. Another function of the sensor interface 70P is to determine the various dynamic states in which the wireless sensor unit 100P may be undergoing. For example, a static state (no movement) and an active state (movement) may be detected by the motion sensor 75P. When in the static state, automated power conservation functions may be enacted to save battery power 45P.

[0059] In a further example, the sensor interface 70P may be used to monitor a user’s interaction with the one or more push-button switches 60A, 60B. Alternatively, the push-button switches 60A, 60B may be augmented or replaced with capacitive sensing circuits (not shown) and/or other touch sensitive type circuits (not shown) within the relevant art. A separate interrupt circuit (not shown) may be incorporated into the device to aid the communications infrastructure 90P, sensor interface 70P, user interface 60P, and/or an optional audio subsystem 80P and audio output device 95P such as a speaker or buzzer.

[0060] The motion sensor 75P operatively coupled to the sensor interface 70P may include single and multi-axis accelerometers 75P, a proximity antenna 85P, an inclinometer, or a momentary switch. An integrating circuit (not shown) may be operatively coupled to the accelerometer 75P and timing circuit 15P to provide velocity and displacement information. Accelerometers are preferred in implementations where ruggedness and costs are of primary consideration. Accelerometers 75P are generally low in cost and may be configured or selected to determine instantaneous and/or average accelerations acting upon the wireless sensor unit casing 200P in which the electronics are incorporated into.

[0061] The motion sensor 75P produces signals indicative of a dynamic motion event involving the casing 200P. In this embodiment, the processor 5P is programmed to process the signals produced by the sensor 75P and wirelessly transmits the processed motion signals to the portable computing device 100C. The portable computing device 100C is programmed to monitor sensor readings, determine the completion of an exercise repetition based upon the time varying profile of the sensor readings, and maintain a count of exercise repetitions based upon the determination.

[0062] An optional audio subsystem 80P and internal speaker 95P may be provided to supplement or replace the optional audio subsystem described for the portable computing device 100C. The audio subsystem 80P may further be programmed to emit periodic tones for locating a lost wireless sensor unit casing 200P. In another exemplary embodiment, the wireless sensor unit 100P is an RFID chip encompassed within the wireless sensor unit casing 200P; the RFID chip may be configured to relay sensor readings to an RFID scanner 70.

[0063] In this exemplary embodiment, the processor 5P, memory 10P, transceiver (i.e., transponder) 65P and communications infrastructure 90P are integrated into a single chip in which a wire loop antenna 85P is connected. In an exemplary embodiment, the RFID chip 100P within the wireless sensor unit casing 200P is passive, drawing all power from an RF signal emitted by the portable computing device.
device 100C. In other exemplary embodiments, the RFID chip is active, drawing power from a battery or other power source 45P on board the wireless sensor unit 100P. An advantage of an active RFID chip is that it can be generally detected from a longer range by a portable computing device 100C than a passive RFID chip.

[0064] The wireless sensor unit 100P may be encompassed in various form factors, although a generally small and unobtrusive object is preferable to allow it to be affixed to and/or incorporated within a variety of pieces of exercise equipment that are moved by users in a repetitive manner. The wireless sensor 100P may be configured to be magnetically affixed to a moving portion of a piece of exercise equipment or clipped and/or strapped to a user or his or her clothing.

[0065] Referring to FIG. 2, a plastic casing 200P is used as the wireless sensor unit and is provided in a lightweight and highly portable form factor. The casing 200P is configured of a size and shape that is easily carried in a user’s pocket and may be selectively affixed to a variety of pieces of exercise equipment. Since many common pieces of exercise equipment are comprised of ferrous metal, a magnet 210 is included within the plastic casing 200P as a means of affixing the wireless sensor unit 100P to the movable portion of a piece of exercise equipment.

[0066] In this way, the plastic casing 200P may be easily affixed to free weights such as dumbbells and/or barbells. Similarly, the magnet 210 incorporated within the plastic casing 200P may be easily affixed to the movable weights and/or other movable components of universal exercise equipment such as bench press machines, shoulder shrug machines, curl machines, leg press machines, and/or other similar machines that have moving weights and/or other moving metal components that move in a repetitive manner during exercise.

[0067] In this way, the unit becomes highly flexible, enabling the monitoring of both repetitive body motions and/or repetitive exercise equipment motions. Also, in exemplary embodiments, the sensor unit may be affixed to the hand or wrist of the user, thereby tracking repetitive exercise motions during weight lifting activities. In such an embodiment, the user wears a wristband that includes a magnetic surface to which the sensor unit may be selectively affixed. In general, the motion sensor 100P is disposed at a location and in a manner such that as a user performs a repetitive exercise activity set, the sensor provides an acceleration signal with a time varying profile, the form of the time varying profile including a cyclic signal in which each cycle generally represents or is indicative of a single repetition of the repetitive exercise event.

[0068] Internal to the casing 200P are the various components that enable the wireless sensor unit to detect physical motion and convey data representative of the physical motion to the portable computing device 100. These internal components include the control electronics 100P, motion sensors 75P, and a wireless transceiver 85P. The control electronics 100P generally include a processor 5P and a communication infrastructure 90P. Not shown is a power source 45P which may include rechargeable batteries. In general, the control electronics 100P reads data from the motion sensor 75P, processes the data, and then transmits a representation of the data over the wireless transceiver 85P to the portable computing device 100C.

[0069] The motion sensor 75P may be a single axis accelerometer that detects acceleration along one degree of freedom or may be a multi-axis accelerometer 75P that detects acceleration along multiple degrees of freedom. In some common embodiments, the accelerometer 75P is a three axis accelerometer that detects acceleration in three orthogonal degrees of freedoms commonly referred to as X, Y and Z. A single resultant vector of the multiple acceleration signals may be processed by the sensor electronics 100P or each directional component may be individually processed. The processing of the motion data may include simple data filtering, averaging, and/or attenuation. The processing of the motion data may include processing of the time varying profile of the motion signal to determine the presence of cyclic characteristics indicative of a motion event. Thus, the wireless sensor unit 100P may convey raw or largely unprocessed data to the portable computing device 100C, or may report a highly abstracted processing of the data such as an indication of rep completions. In this way, the processing of the data may be distributed among the wireless sensor unit 100P and the portable computing device 100C in a variety of ways.

[0070] In an exemplary embodiment, the wireless sensor unit 200P may be incorporated into a portable computing device 100C, thereby not requiring any communication link. In such an embodiment, the portable computing device may include the magnet 210 such that it can be selectively affixed to the movable piece of exercise equipment during rep-counting activities. In such embodiments, the portable computing device 100C ideally includes a wireless link 85 to headphones worn by the user. In this way, a user may clip the portable computing device 100C to a piece of exercise equipment, for example a dumbbell or barbell or other moving weight, while still being able to easily listen to audio content from the portable computing device.

[0071] It should be noted that in some exemplary embodiments the sensor unit 200P may be worn by the user to monitor repetitive exercise activities such as push up, chin ups, and sit ups that involve lifting and lowering the user’s own body instead of an external weight. In such an embodiment, the user may grasp the sensor unit 200P within his or her hand, for example during sit-ups, or may affix it by Velcro or a strap to his or her belt or shirt or other article of clothing.

[0072] Alternately, a user may want to affix the sensor unit 200P to his or her person for some activities and affix the sensor unit to dumbbells, barbells, weights, and/or other pieces of exercise equipment for other activities. The user may also be provided with a belt and/or other article of clothing that includes a metallic and/or magnetic pad intended for affixing the magnetic portion of the wireless sensor unit 200P. In this way, the user may affix the sensor unit 200P to his or her person by the magnet when performing sit-ups, push-ups, pull-ups, and/or other similar repetitive body activities, and may affix the unit to barbells, dumbbells, and/or other movable hardware of actual exercise equipment.

[0073] Additionally, the user may affix the sensor to his or her wrist for certain exercise activities by use of a wrist band or other similar element. Again the wristband may include a metallic or magnetic area which allows the sensor unit to be detached and affixed to other exercise equipment hardware or other body parts. For example, a user may selectively affix the sensor to different body areas for different exercise activities performed as part of a single exercise session, for example to his or her wrist for dumbbell curls, to his or her
shirt for push-ups, and to his or her ankle for left lifts. In this way the motion sensor data may be selectively collected from the appropriate body area based on the required motion of the exercise activity set being performed.

[0074] Referring to FIGS. 3A and 3B, analog output signals from a motion sensor 100P are depicted in which three repetitions of two different types of exercise activities are provided. The output signal from the motion sensor 100P includes a time varying profile indicative of the sequence of repetition events performed by a user’s exercise activity. FIGS. 3A and 3B depict accelerometer data collected from a single axis accelerometer sensor included within a wireless sensor unit 100P and communicated by wireless link to a portable computing device 100C.

[0075] In an exemplary embodiment, the portable computing device 100C is configured to process the output signal from the motion sensor 100P to determine if and when singular repetitions of the exercise activity set are performed and maintain a cumulative count of the repetitions over a period of time. Determine the completion of an exercise activity set and based upon the completion of such exercise activity set, track progress through a pre-planned exercise regimen for a number of different exercise activity sets. In this exemplary embodiment, the analog output from the motion sensor 100P is sampled by an analog to digital converter at approximately 100 millisecond intervals which should be more than adequate to capture the motion events from the motion sensor 100P.

[0076] As is shown in FIGS. 3A and 3B, the accelerometer data is graphed as a voltage signal 310A, 310B which is proportional to acceleration such that 2100 millivolts (mV) is a nominal acceleration of 0 g's and fluctuations above and below 2100 mV depicts positive and negative accelerations imparted upon the wireless sensor unit 100P respectively. The data is graphed over time 305A, 305B on a scale of seconds, each graph depicting a 10 second long portion of an exercise activity set engaged by a user.

[0077] FIG. 3A is derived from a user engaged in a dumbbell curl exercise activity set using a free weight dumbbell during the time that this segment of data was collected. The motion data captured by the accelerometer depicts a characteristic time varying profile such that each repetition 315A, 315B, 315C of the curl exercise imparts a distinguishable time dependent motion event. The portable computing device 100C is configured to receive and process the data and determine from if a motion event is present and if so increment an internal rep-counter variable. The portable computing device 100C may also be configured to determine if a required number of counts have been reached for a current exercise activity set of a current exercise regimen, and if so, determine that exercise activity set to be complete and then prompt the user to a next exercise activity set and exercise type of the current exercise regimen.

[0078] There are many signal processing techniques known in the relevant art by which the data can be processed to count the characteristic cyclic data profiles indicative of a single repetitive event. For example, an upper and lower signal threshold may be set and the data is processed to assess the exceeding of the upper and lower signal threshold within certain time constraints. If the data is determined to exceed the upper and lower signal thresholds within the time constraints, it may be inferred that a characteristic repetitive event is present within the time varying signal representative of an exercise repetition. In some exemplary embodiments, several threshold levels may be used to further refine the processing to avoid spurious signal responses caused by the user positioning the exercise equipment for use. Alternately, pattern matching routines may be used to assess the data for characteristic signal profiles.

[0079] FIG. 3B is derived from a user engaged in a bench press exercise activity set during the time that this segment of data was collected. The bench press exercise involves different physical motions and different exercise equipment from the dumbbell curl. However, the data follows a similar characteristic cyclic time varying profile to that of the dumbbell curl which is likewise highly prominent in the motion sensor data and easy to identify by the signal processing techniques known in the relevant art. For the bench press exercise, the motion data captured by the accelerometer depicts a characteristic time varying profile such that each repetition 320A, 320B, 320C of the curl exercise imparts a distinguishable time dependent motion event. Analogous to the dumbbell curl described above, a time varying data profile collected during three consecutive repetitive bench press exercises 320A, 320B, 320C performed by the user during a ten second time period is output to the portable computing device 100C.

[0080] Upon determining that a motion event has occurred, a counter variable is changed from 0 to 1, indicating that 1 rep has been counted. At the same time the portable computing device 100C may be configured to output the number “1” upon the display 25 of the portable computing device 100C indicating that one rep has been performed. At the same time, the portable computing device 100C may be configured to output an audible sound conveying the vocal word “one” to the user through the headphone interface 95.

[0081] In this way, the user hears a voice saying “one” as he or she completes the first rep 320A. The sequential visual and/or audible output may continue for each detected motion event 320B, 320C respectively until the user finishes the required number of repetitions of exercise activity set as indicated by the stored exercise regimen.

[0082] In an exemplary embodiment, the personal computing device 100C may be configured to stop counting when an elapsed time for the exercise activity set has exceeded a certain threshold or if the elapsed time for a single repetition has exceeded a certain threshold without a next characteristic sensor signal being detected. For example, if more than 10 seconds elapsed after the last detected motion event, the software may be configured to assume the user ceased performing the exercise activity set.

[0083] In an exemplary embodiment, if a user performs a rep at a rate (or at a total time) slower than a defined minimum threshold value, the system may output a verbal prompt such as “speed up” or “too slow.” In addition, if a user performs a rep at a rate (or with a total time) faster than a required maximum threshold value, the system may output a verbal prompt such as “slow down” or “too fast.” In addition, if a user is taking longer than some threshold value, the portable computing device 100C may output a motivational phrase such as “push it out.”

[0084] Upon completion of the required number of repetitions, the portable computing device 100C may also be configured to output a supportive message visually or through an auditory output of spoken language. The portable computing device 100C may also output performance information and/or statistics about the activity set including the
elapsed time required to complete the activity set and/or an assessment metric. For example, the exercise activity set, comprising 10 repetitions of a particular exercise type, may have taken 22.6 seconds to complete. This data may be displayed visually upon the display 25 oraurally 95 as an audio message to the user.

[0085] In an exemplary embodiment, once the prescribed number of repetitions of a prescribed exercise activity set has been completed by the user and counted by the routines of the present system, a next prescribed exercise activity set is automatically accessed from the current exercise regimen and the user is prompted as to the nature of the next exercise activity set. For example a textual and/or verbal message may be output such as “Next Up, Sit Ups, incline bench, 50 reps.” In some exemplary embodiments, a pictorial representation may also be output on a screen 25 of the portable computing device 100C.

[0086] Referring to FIG. 4, an exemplary embodiment of the portable computing device 100C is shown, complete with a sample screen shot output to the display 25 of the device. The sample screen shot may display various pieces of information related to a current exercise regimen being performed by a user. For example, the portable computing device 100C is configured to display the current exercise activity set 415 of the current exercise regimen being performed by the user. In this case, “Right Curl, 20 lb.” In this way, the type of exercise of the current exercise activity set as well as the prescribed weight level to be used during the exercise activity set are both provided to the user as informational output. The device may also output the required number of reps to complete an exercise activity set. This is shown as the lower number in display box 425. In this way, the user knows what exercise activity set he or she is to be performing at any given time during an exercise session, including what weight level and how many reps to be performed. In this example, the user is informed that the current exercise activity set in the current exercise regimen is a prescribed exercise type of a Right Curl, a prescribed exercise weight of 20 lbs, and a prescribed number of repetitions of 12 reps. The total time 410 that has elapsed since the current exercise regimen has begun for the user may also be displayed.

[0087] An index number 405 may also be displayed for the current exercise activity set in the exercise regimen. In this example, the index number is displayed as “1/20” indicating that the current exercise activity set is the seventh in the required sequence of twenty defined by the current exercise regimen. In this way, the user knows where he or she is within a current exercise regimen. The current elapsed time 420 may also be displayed in which the time that has elapsed for the current exercise activity set (i.e. for the current right curl of 20 lbs). Finally, the current repetition count 425 for the exercise activity set that is currently being performed may also be displayed. This is shown as “1/20”, indicating that 8 of the required 12 repetitions have thus far been completed. As previously discussed, the data displayed 25 may also be presented simultaneously with audio prompts and/or with the playing of musical media by portable computing device 100C.

[0088] Referring to FIG. 5, an example graphical report output to a display 25 of a portable computing device 100C is depicted. The graph 500 provides elapsed repetition count 505 versus elapsed time 510 during a current exercise activity set. The graph 500 provides a visual representation of the rep-time for each sequential repetition within an exercise activity set. This is achieved by graphing the repetition count 505 (i.e. the number of completed full repetitions of the exercise activity set) upon the vertical axis against the accrued time 510 upon the horizontal axis, thereby presenting visually how long each repetition took to complete. The graph 500 depicts a characteristic stair-step pattern in which each step corresponding to a single repetition of an exercise activity set, the horizontal length of the step corresponding to the amount of time the user required to complete the repetition (i.e. the rep-time.) The graph thus shows the completion of 11 repetitions of a bench press activity set, graphed versus time, thereby showing visually how the user’s rep-times varied during the exercise activity set.

[0089] Thus, by viewing the change in step size across the characteristic stair-step pattern, the user can quickly assess how his or her rep-time varied across an exercise activity set, the larger the steps, the longer the rep-times. As is typical of an exercise activity set, the rep-times increase as the user proceeds through the exercise because of muscle fatigue. This is shown visually in FIG. 5 by the example stair-step pattern in which the last few steps become more elongated as compared to the first few steps.

[0090] This unique graphing format allows a user to quickly and easily view how his or her rep-times slowed towards the end of an exercise activity set as compared to the beginning of the exercise activity set. In general, if the rep-times slows too much (i.e. the steps elongate greatly), the user struggled with the exercise activity set, but if the rep-times don’t slow much at all (i.e. the steps remain similar in size), the set may have been too easy for the user. Thus, this unique graphic format may enable a user to quickly assess his or her performance in an exercise activity set.

[0091] FIG. 6 provides an example information display 500 shown as it may appear upon screen 25. The example information display 500 again includes a graph of repetition count versus accrued exercise time for the set as shown in stair-step pattern 605. Also shown is a slope line 610 that indicates the central slope defined by the first few reps in the set. In this example, the slope line is determined by performing a best fit linear fit to the first four reps in the set. This slope line therefore represents how the stair step pattern would proceed if there was no slowing after the fourth rep in the set. Since there is apparent slowing as the user fatigues across the set, the actual stair step pattern diverges from the linear curve fit of the slope line 610.

[0093] The slope line 610 is drawn upon the graph such that a user can easily view how the stair step pattern 605...
diverges from the linear fit 610. The amount of divergence between the stair step line 605 and slope line 610 for the final reps in the set visually indicates to the user the amount of slowing in rep time that has occurred during the exercise activity set. If the slowing is significant, the user may determine that he or she struggled and may adjust the weight or equipment settings accordingly in future exercise activity sets. If the slowing is minimal (i.e., the stair step line 605 does not diverge much from the slope line 610), the user may quickly assess that the exercise activity set was too easy and adjust the exercise activity set accordingly in future exercise activity sets. In such a case the user may decide in the future to increase the weight and/or increase the number of reps of that particular exercise activity set within the exercise regimen.

In addition to the slope line 610, other quantification information may be determined and displayed to the user. This information is shown within the display 25 at information area 600. The numerical information may be displayed to the user including the Total Reps (i.e., the total number of reps performed in the graphed exercise activity set), the Total Time (i.e., the total amount of time elapsed during the graphed exercise activity set), the Average Rate (i.e., a measure of the average speed at which reps were performed, in this case in reps per minute), and the First-to-Last Deceleration, which is a numerical metric of the amount of slowing between the initial reps and the final reps in the set. There are a variety of ways in which First-to-Last Deceleration may be determined and displayed. In this example, the deceleration may be determined from the change in repetition rate performed by the user from the first rep in the set to the last rep in the set. More specifically it is a measure of the percentage reduction in repetition rate between the first rep in the set and the last rep in the set.

In this particular example, the repetition rate dropped by about 78%. This means that final rep was performed at a speed that was approximately about 12% of the speed of the first rep. This metric quickly indicates the amount of slowing that occurred across the set. The deceleration metric may be also be used to determine if the set was established at a sufficient difficulty level for the user, not being too easy or too hard.

If the deceleration metric is determined to be too small (i.e., not enough slowing occurs between the first and last reps), this may indicate that the set was not difficult enough for the user. Thus, in response to computing a low deceleration metric, the software of the present system may be configured to automatically increase the prescribed weight or prescribed number of reps in a future set of the current exercise regimen and/or in a future set of a future exercise regimen. Conversely, if the deceleration metric is determined to be too large (i.e., too much slowing occurs between the first and last reps), this may indicate that the set was too difficult for the user. Thus, in response to computing a low deceleration metric, a programmatic function may be configured to automatically decrease the prescribed weight or prescribed number of reps in a future set of the current exercise regimen and/or in a future set of a future exercise regimen. In this way, portable computing device 100C may automatically adjust a current or future exercise regimen of the user to ensure that exercise activity sets are not too easy or too hard, based upon the user's current actual fitness capabilities.

In an exemplary embodiment, a determined deceleration metric may be considered too great if more than an 85% reduction in rep rate is detected between the initial rep and the final rep. In response to such a deceleration metric, a future set may automatically be decreased in weight and/or rep count. Alternately, a deceleration metric may be determined to be too small if less than a 20% reduction in rep rate is detected between the initial rep and the final rep. In response to such a deceleration metric, a future set may automatically be increased in weight and/or rep count.

Referring to FIGS. 7A and B, an exemplary embodiment enables two exercise activity sets to be graphed side by side upon the display screen 25 of the portable computing device 100C. This feature allows a user to quickly compare the performance of one set to another set. An additional feature generates a desired performance curve that the user is trying to obtain to be overlaid on the actual performance graph.

Thus, by viewing both side by side, the user can assess how close his or her actual performance data 700A matches the reference performance data 700B for a particular exercise activity set. The desired performance curves may be stored in memory for many different exercise types and styles and performance goals, enabling a user to compare his or her current exercise activity set with a specific reference set that most closely matches a desired target.

In the example shown, FIG. 7A may represent an exercise activity set that was just performed by the user and FIG. 7B may represent an exercise activity set that was performed a few weeks prior by the user. The user may visually compare his or her progress in exercise performance over the intervening weeks using this side-by-side comparison. As shown the in the figures, the characteristic stair step pattern 610B slows less in FIG. 7B than the stair step pattern 610A of FIG. 7A. This indicates that the user performed the current exercise activity set (i.e. a Bench Press exercise of 100 lbs) with greater ease in FIG. 7B than in FIG. 7A. In addition, some exemplary embodiments may enable the two graphs to be displayed as co-located overlays on the same graphing axis. This too enables a user to quickly compare his or her current performance to a previous performance and/or to a reference performance.

Referring to FIG. 8, another graphical display example for evaluating user performance in an exercise activity set is shown. In this exemplary graph 800, a power-per-rep graphing feature is represented in which the user's performance data in an exercise activity set is graphed as user power output 805 versus repetition count 810. The value of this graphing method is best understood by first explaining how user power output may be determined for each repetition of an exercise.

As is well known in physics, power is a measure of energy expended over time. The power of a moving activity is often computed by multiplying the force required to propel the activity by the velocity of the activity itself. Thus, a common equation for power is represented as \( P = F \times V \); where \( P \) is the power, \( F \) is the force, and \( V \) is the velocity of the activity. It is also well known that \( F = m \times a \) and \( V = X/t \); where \( m \) is the mass of the moving object, \( a \) is the acceleration of the moving object, \( x \) is the distance traveled by the moving object and \( t \) is the time the moving object traversed the distance \( x \). These equations may be combined to yield \( P = m \times a \times X/t \). Thus, the power output by a user during a
repetition of an exercise activity set, for example a single rep of bench press exercise, is a function of the mass lifted, the acceleration imparted, the distance the mass was moved and the time required for completion of the rep. This equation may be simplified for comparative purposes because in general, the mass lifted and the distance traveled during each rep of an exercise activity set is the same. Therefore, to compare the power from one rep to another rep in an exercise activity set, a normalized measure of power may be computed that drops out the values for mass and distance.

This yields a simplified normalized equation for Relative Power Output (RP) = a/t. As such, the relative power output of a user during an exercise rep of a particular exercise may be determined by dividing the average acceleration of the exercise rep by the elapsed time of the exercise rep. Both of these values are readily available from the accelerometer data.

In some exemplary embodiments, peak acceleration may be used because it generally varies proportionally with the average acceleration. The RP for each rep is then stored and indexed with respect to the rep it corresponds to. The resulting set of RP values for rep count index may then be graphed as a bar graph 800, each bar indicating the RP for that rep in the set. This example graph is shown with respect to FIG. 8 and is labeled the Power Curve 815 for the set. As shown, the graph 800 is an indication of Power Output (in normalized RP format which is unitless) 805 on the vertical axis versus rep count on the horizontal axis 810. Because the power output are unit-less numbers that indicate relative power, not absolute power, they may be graphed on an arbitrary scale or on a percentage scale, the percentage being the percent of some full power value. The graph 800 drawn shows Power Output graphed as percentages, the percentage values indicating the percent of the maximum expected power output for the given user based upon his or her past performance.

The value of such a Power Curve graph as shown is that it provides the user with an indication of how his or her power output varies across an exercise activity set. Generally, the power output begins near the maximum value and gradually decreases as the user fatigues. In this particular example graph, the power output starts at approximately 92% of the maximum value during the first executed rep of the exercise and decreases at an increasing rate across the set until it finishes at approximately 20% of the maximum value during the last executed rep of the exercise.

In this way, the user can easily visualize how the power output of his or her repetitions varies across the set. In general, a user attempts to keep their power output from falling below a certain minimum across a set, for example from falling below 40% of their target maximum value. In this particular exercise activity set, the last repetition does fall below this value, indicating to the user that he or she needs to try harder next time to keep the power output up across the full repetitive exercise activity set. In some exemplary embodiments, an estimated value for total calories burned may be output for a weight lifting set or other similar repetitive exercise activity set.

The total calories burned is generally proportional to the total mechanical work performed by the user during the repetitive weight lifting set, adjusted with a metabolic rate constant. For weight lifting exercises, the total mechanical work is generally proportional to the amount of weight that is lifted during each rep, the distance it is raised and lowered during each rep, and the number of repetitions performed.

Thus, the calories equation is generally computed with consideration for the type of exercise, weight of exercise, and number of reps of exercise, for each exercise activity set as stored within the preplanned exercise regimen. This data may be accessed from the predefined exercise regimen script. The total calories burned may be determined by summing calories across the cumulative number of exercise activity sets performed for an exercise regimen. The total calories burned may be displayed as an accrued value during the preplanned exercise regimen. This enables the portable computing device 100C to determine approximate calorie count across a complex exercise regimen comprised of varying exercise type, exercise weight levels, and exercise repetition count value.

Referring to FIGS. 9A-D, the various exemplary embodiments described above may be accomplished for a wide variety of stationary exercise activities. For example, a user may affix a magnetically equipped motion sensor 200 to the weight portion of a weight-based piece of exercise equipment 910A, 910B. Upon movement of the weights 910A, 910B, the magnetically affixed motion sensor 200 detects the motion induced 910A, 910B upon the weights in response to the user performed exercise activity set which is received by a portable computing device 100C attached for example to the waist of the user. Alternately, the motion sensor 200 may be strapped to an arm of the user as is shown in FIG. 9A.

The exercise equipment may be a traditional free weight bench press 900A or part of a universal style exercise machine 900B. In a traditional bench press 900A, the physical weights 910A are raised and lowered in response to a user’s bench press while lying prone on the bench portion of the weight stand. A magnetic wireless motion sensor 200 is affixed to the weights 910. As the user performs the bench press exercise, the weights are raised and lowered 915A. The induced motion is detected by the motion sensor 200 in which the motion data is transmitted wirelessly to the portable computing device 100C. The portable computing device 100C monitors the exercise, counts repetitions for the user, stores exercise metrics, and displays information representing the number of repetitions of the weight lifting exercise activity set to the user during a current exercise activity set as well as prompting the user for a next exercise activity set.

This arrangement is performed similarly when using the universal style exercise machine 900B. For this embodiment, the user affixes the magnetic wireless sensor 200 to the uppermost weight in the stack 910B. The user then selects the amount of weight to lift and begins his or her exercise. As the user performs the bench press exercise, he or she is lifting and lowering a portion of the weights in a repetitive motion 915B. The magnetic wireless sensor 200 is lifted and lowered and thus captures characteristic cyclic sensor data which is transmitted wirelessly to the portable computing device 100C as described above.

In FIG. 9D, a user is disposed on an abdominal curl machine. In this exemplary embodiment, the user himself is the weight which will be moved. The portable computing device 100C may be affixed as before to a waistband of the user. The motion sensor 200 may be strapped to the user’s arm as described above or is incorporated into the portable
computing device 100C. As the user begins the abdominal curl, the motion sensor detects the user’s movement which is received and processed by the portable computing device 100C.

As previously described, the portable computing device 100C monitors the exercise, counts repetitions for the user, stores exercise metrics, and displays information representing the number of repetitions of the weight lifting exercise activity set to the user during a current exercise activity set as well as prompting the user for a next exercise activity set and/or type.

**Programmatic Features**

FIG. 10 depicts a process flow chart for the various exemplary embodiments described herein. The process is initiated by coupling a motion sensor to a portable computing device. The user then selects an exercise regimen from a menu displayed on the portable computing device.

The selected exercise regimen is retrieved from the datastore and executed by the portable computing device. The selected exercise regimen outputs and/or prompts the user to perform a prescribed exercise activity set. Based upon the type of exercise activity set prescribed by the regimen, the motion sensor is then affixed to a moving portion of an appropriate piece of exercise equipment or to a body part of a user that moves sufficiently for data collection during the particular type of exercise activity set. The user then begins the exercise activity set which causes the motion sensor to detect motion events which are then transmitted to the portable computing device. The portable computing device receives the time-dependent motion signals from the motion sensor and determines time-dependent repetitive events from the received motion signals.

In addition, the portable computing device determines repetition counts from the repetition events which are then recorded in a datastore indexed to the current exercise activity set. The datastore maintains a variety of exercise regimens and data recorded from the user’s exercise activities including the repetition count, exercise performance data, elapsed time between repetition events, elapsed time between exercise activities, completed exercise activity sets, duration of rest periods taken by the user, and deferred exercise activities.

During performance of the user exercise activity sets, the portable computing device monitors the repetition events and determines if the user is performing the exercise within predefined exercise tolerances. If the user is not performing the exercise activity sets within these predefined tolerances, the user is prompted to either slow down or speed up to keep pace with the prescribed exercise activity sets. This prompt may be conveyed as an audio signal conveyed through headphones, for example as a verbal prompt.

An exemplary embodiment, the user may be provided with a number of options with respect to how an exercise regimen is stored and/or processed. For example, the user may request that the order of exercise activity sets within the exercise regimen may be randomized, updated, or reordered. If the user chooses to either update or reorder an exercise regimen, the portable computing device changes the exercise regimen in the datastore then continues monitoring and orchestrating the individual exercise activity sets contained within the changed exercise regimen as previously described. For example, an exercise regimen may comprise a plurality of different exercise activity types, each with an associated number of repetitions and weight levels. The exercise regimen generally also defines a specific order in which the plurality of different exercise types is to be performed by the user. Alternately, the user may request that the order in which the exercise types are automatically selected and performed be shuffled, adjusted, or even randomized such that the user is provided with variety when performing the exercise regimen numerous times across various exercise sessions.

Alternately, the user may decide to defer a current exercise activity set after being prompted to perform that exercise activity set by the computing device. For example, if the equipment he or she desires to use during the particular exercise activity is currently being used by another person, the user may request that the particular exercise activity be deferred until a later time during the exercise regimen. Alternately, if a user is too fatigued to perform a particular exercise activity set at the current time, the user may request that the exercise activity set be deferred until a later time during the exercise regimen. If the user chooses to defer an exercise activity set, the user will be prompted in the future to perform the deferred exercise activity set. Changes to an exercise regimen and/or deferrals are stored in the datastore for later review by the user.

In addition, to moderating the order of exercise activity sets to be performed by the user, programmatic functions may also moderate the rest periods provided to the user between exercise activity sets. For example, once an exercise activity set is completed by a user, the routines may provide a predetermined rest period to the user before the next exercise activity set is required to be performed. The programmatic functions track the elapsed time after a current exercise activity set has been completed and before a next exercise activity set is begun, optionally displaying the elapsed time to the user along with an indication of the total allowed rest time. The user may be prompted when a rest period is about to expire or has expired.

Lastly, if the user wishes to examine his or her exercise performance, the user selects the desired data output which causes the portable computing device to analyze the stored exercise performance data and/or metrics which is then graphically output to the user. A variety of graphical presentations are available including completed exercise activity sets, repetition rates, relative power outputs, exercise types, changes in repetition rates, changes to the exercise regimens, etc.

If the exercise regimen has not been completed, the user is returned to the next exercise activity set until either the user chooses to end the exercise session or the exercise regimen is completed as prescribed.

Referring to FIG. 11, an exemplary hierarchical data structure for an exercise regimen is depicted. An exercise regimen generally includes several different exercise activity sets which are to be performed by the user, each exercise activity set comprising one of a plurality of different exercise types that require one of a plurality of pieces of exercise equipment or configurations. Each exercise activity set includes one or more exercise types for a specific exercise activity set and each exercise type includes a number of repetitions to be performed by the user to complete the
exercise activity set. Each exercise activity set generally also includes a particular weight level or setting level to be used during the set. Each exercise activity set may also include one or more predefined performance targets, for example one or more target rep-times and/or target set-times for the reps of the set. Each exercise activity set may also include a predefined rest-time that is allowed after the exercise activity set is completed and before a next exercise activity set is begun. Each exercise activity set may also be stored along with one or more equipment settings for the user when performing that set, for example a seat-location setting on an exercise machine.

Exercise Regimen

[0125] An exercise regimen comprises one or more exercise scripts which may be retrievably stored in a datastore. Each exercise regimen includes a number of distinct exercise activity sets, each with a predefined number of repetitive motions. The exercise regimen may be entered by the user, selected by the user, downloaded by the user, and/or generated for the user based upon user input and historical data. The exercise regimen also may include a set of exercises to be performed by the user, the regimen indicating the type of exercise, the weight level or other setting level required of the exercise, and the number of sets and reps to be performed by the user. For example the script may indicate that the user perform 3 sets of 10 arm curls at a weight of twenty pounds. The portable computing device 106C may be configured to read the regimen from memory and instruct the user to perform the required tasks. An example of an exercise regimen, displayed in a tabular format is provided in Table 1 below.

<table>
<thead>
<tr>
<th>Sequence Index</th>
<th>Exercise Type</th>
<th>Exercise Group</th>
<th>Exercise Code</th>
<th>Repetition Qualifier</th>
<th>Allotted Rest Time</th>
<th>Allotted Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Sit Ups</td>
<td>1</td>
<td>156</td>
<td>Incline</td>
<td>25</td>
<td>20 sec</td>
<td>30 sec</td>
</tr>
<tr>
<td>2 Sit Ups</td>
<td>1</td>
<td>156</td>
<td>Incline</td>
<td>25</td>
<td>20 sec</td>
<td>30 sec</td>
</tr>
<tr>
<td>3 Bench Press</td>
<td>2</td>
<td>124</td>
<td>Incline</td>
<td>12</td>
<td>40 sec</td>
<td>20 sec</td>
</tr>
<tr>
<td>4 Bench Press</td>
<td>2</td>
<td>124</td>
<td>Incline</td>
<td>12</td>
<td>40 sec</td>
<td>20 sec</td>
</tr>
<tr>
<td>5 Bench Press</td>
<td>2</td>
<td>124</td>
<td>Incline</td>
<td>12</td>
<td>40 sec</td>
<td>20 sec</td>
</tr>
<tr>
<td>6 Left Curl</td>
<td>3</td>
<td>167</td>
<td>20 lb</td>
<td>12</td>
<td>20 sec</td>
<td>25 sec</td>
</tr>
<tr>
<td>7 Right Curl</td>
<td>3</td>
<td>168</td>
<td>20 lb</td>
<td>12</td>
<td>20 sec</td>
<td>25 sec</td>
</tr>
<tr>
<td>8 Left Curl</td>
<td>3</td>
<td>167</td>
<td>25 lb</td>
<td>10</td>
<td>5 sec</td>
<td>25 sec</td>
</tr>
<tr>
<td>9 Right Curl</td>
<td>3</td>
<td>168</td>
<td>25 lb</td>
<td>10</td>
<td>5 sec</td>
<td>25 sec</td>
</tr>
<tr>
<td>10 Left Curl</td>
<td>3</td>
<td>167</td>
<td>30 lb</td>
<td>8</td>
<td>5 sec</td>
<td>25 sec</td>
</tr>
<tr>
<td>11 Right Curl</td>
<td>3</td>
<td>168</td>
<td>30 lb</td>
<td>8</td>
<td>20 sec</td>
<td>25 sec</td>
</tr>
<tr>
<td>...</td>
<td>...</td>
<td>...</td>
<td>...</td>
<td>...</td>
<td>...</td>
<td>...</td>
</tr>
<tr>
<td>N Cool Down</td>
<td>N</td>
<td>9999</td>
<td>null</td>
<td>null</td>
<td>null</td>
<td>300 sec</td>
</tr>
</tbody>
</table>

[0126] This exemplary exercise regimen includes a sequential listing of required exercise activity sets of the user. Each exercise activity set includes a sequence index which indicates the sequential order in which the exercise activity set is to be performed; an exercise type indicates the type of exercise activity to be performed; a code is used as an index value for a particular exercise type; an exercise qualifier indicates the weight value, equipment setting or other exercise parameter for an associated current exercise activity; a repetition quantity indicates the number of repetitions the user is to perform; an allotted rest time indicates how much time the user may rest after completing the consecutive sets of the same exercise activity in the regimen are maintained in their prescribed order. Therefore, if an exercise regimen consisted of three activity sets of bench press, each of different weight value and rep counts, three sets of shoulder press, each of different weight value and rep counts, and three sets of sit ups, each of different rep counts, regimen reordering will maintain the prescribed order of the three sets of bench press, the prescribed order of the three sets of shoulder press, and the prescribed order of the three sets of sit ups, only varying the relative order of the three different exercises (bench press, shoulder press, and sit ups.)
[0131] In another exemplary embodiment, the exercise regimen may be also associated with a muscle group they intend to work, for example abdomen muscles (i.e. abs), pectoral muscles (i.e., "pecs," etc.). Regimen reordering routines may be operative to maintain the grouping of exercises that target a common muscle sets, thereby keeping all the exercises, for example, that are relatively associated with the regimen with abdomen muscles, grouped together in the randomized regimen. In this way, a user may randomize or otherwise vary the order of a preplanned exercise regimen, but still maintain groupings of exercises in consecutive order by virtue of each exercise in the groupings being relatively associated with the same piece of exercise equipment and/or by virtue of each exercise in the groupings being relatively associated with the same muscle type.

[0132] A completed exercise regimen is stored in the datastore 10, 30 and may be used for performance comparisons and improvements over time. An example of tabular data stored for an exercise regimen performed by a user, including performance rating values for each exercise activity as well as completion times for each exercise activity set, is provided in Table 2 below.

**TABLE 2**

<table>
<thead>
<tr>
<th>Sequence Index</th>
<th>Exercise Type</th>
<th>Code</th>
<th>Exercise Qualifier</th>
<th>Repetition Quantity</th>
<th>User Performance Time Used</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Sit Ups</td>
<td>156</td>
<td>Incline</td>
<td>25</td>
<td>8</td>
</tr>
<tr>
<td>2</td>
<td>Sit Ups</td>
<td>156</td>
<td>Incline</td>
<td>25</td>
<td>7</td>
</tr>
<tr>
<td>3</td>
<td>Bench Press</td>
<td>124</td>
<td>125 lb</td>
<td>10</td>
<td>6</td>
</tr>
<tr>
<td>4</td>
<td>Bench Press</td>
<td>124</td>
<td>125 lb</td>
<td>10</td>
<td>7</td>
</tr>
<tr>
<td>5</td>
<td>Bench Press</td>
<td>124</td>
<td>135 lb</td>
<td>10</td>
<td>7</td>
</tr>
<tr>
<td>6</td>
<td>Left Curl</td>
<td>167</td>
<td>20 lb</td>
<td>12</td>
<td>7</td>
</tr>
<tr>
<td>7</td>
<td>Right Curl</td>
<td>168</td>
<td>20 lb</td>
<td>12</td>
<td>7</td>
</tr>
<tr>
<td>8</td>
<td>Left Curl</td>
<td>167</td>
<td>25 lb</td>
<td>10</td>
<td>6</td>
</tr>
<tr>
<td>9</td>
<td>Right Curl</td>
<td>168</td>
<td>25 lb</td>
<td>10</td>
<td>5</td>
</tr>
<tr>
<td>10</td>
<td>Left Curl</td>
<td>167</td>
<td>30 lb</td>
<td>8</td>
<td>4</td>
</tr>
<tr>
<td>11</td>
<td>Right Curl</td>
<td>168</td>
<td>30 lb</td>
<td>8</td>
<td>2</td>
</tr>
</tbody>
</table>

N

[0133] In general, when a user completes an exercise activity set, the user takes his or her magnetic wireless sensor unit 200P to the next piece of exercise equipment, as prompted by the portable computing device 100C. In this way, the portable computing device 100C, acts as a personal trainer, instructing the user which exercises activity sets to perform, in which order, and with what counts and weight levels.

[0134] The portable computing device 100C may also be configured to store historical data about the user’s activities and/or display performance statistics such as the total number of activity sets and/or reps performed and/or the elapsed time required of different exercises. A user performance value (on a scale of 1 to 10) is recorded and stored for each exercise activity set in the exercise regimen. Also, a time used value is stored for each exercise activity in the exercise regimen. With respect to computing a performance assessment for a given exercise activity set, for example on a scale of 1 to 10, there are a variety of ways in which a value can be computed that quantifies the ease at which an exercise activity set was performed by a user. In general, when a user performs a set with ease, the rep-times for each rep of the set is performed with minimal slowing (i.e. low deceleration) across the set.

[0135] Conversely, when a user performs a set with considerable difficulty, the rep-times for each rep of the activity set is performed with considerable slowing (i.e. high deceleration) across the set. Thus, the deceleration in rep completion times (i.e. rep-times) across an exercise activity set may be used to quantify the ease or difficulty at which the set was performed. In general, a typical user is aiming to perform sets that are not too easy or too hard, thus a mid-range assessment on the ease-to-difficulty scale may be preferable. Therefore, a mid-range deceleration in rep-times is considered the result of a well-targeted exercise regimen for an average user.

[0136] In various exemplary embodiments, a deceleration metric may be determined that indicates the amount by which the user slows down through the course of an exercise activity set. This deceleration metric is then used to determine a relative performance assessment for the exercise activity set. There are numerous ways in which the deceleration metric may be determined. For example, the deceleration metric may be determined by comparing the rep completion time for the first rep of an exercise activity set with the rep completion time for the last rep of the set. By evaluating the change in rep completion times from the first rep to the last rep, a first-to-last deceleration value may be determined. If that deceleration metric is small (i.e. there is little deceleration), the current set may be too easy for the user and a high performance value assigned. Conversely, if the deceleration metric value is large (i.e. there is a very large amount of deceleration), the current set may be too difficult for the user and a low performance value assigned. The datastore 10, 30 may be used to store data relating to numerous historical exercise sessions. For example, a user might perform a particular exercise regimen once per day, every day, for three weeks.

[0137] As such, 24 sets of data, one for each day the exercise regimen was performed, may be stored in memory 30, each set of data indicating user performance on that instance of performing the exercise regimen. The historical data may be used to generate time-varying user performance data that indicates how a user is progressing over time as he or she performs the same or similar exercise regimens over days, weeks, months, or years.

[0138] The portable computing device 100C accesses an exercise regimen from a datastore 10, 30 tracks a user’s progress through each required exercise activity set by counting time-dependent repetition events and prompts the user to consecutively perform each required exercise activity. The portable computing device 100C may also be programmed to monitor the time required for the user to perform each repetitive event for a given exercise activity, rest intervals taken and/or exercise activity intervals during a particular exercise activity and alert a user when a predefined time period to perform an exercise activity has been reached and/or exceeded.

[0139] Since the portable computing device 100C is programmed to determine repetition events in a time dependent manner, a user may assess his or her performance for an exercise activity set based upon the time interval between repetitive motions (i.e. the repetition interval time). For example, if a user is performing a weight lifting exercise activity and the time interval between repetitive lifting
events of the weights slows substantially over the required count of repetitive events, the portable computing device 100C may determine that the user is struggling with that particular exercise activity set in the required exercise regimen and may heuristically adjust the exertion level or weight setting downward for the user for the next exercise activity using the same targeted muscle group.

[0140] Conversely, if the user is performing a weight lifting exercise activity and the time interval between repetitive lifting events of the weights remains relatively constant or accelerates over the required count of repetitive events, the portable computing device 100C may determine that the user is unchallenged with that particular exercise activity in the required exercise regimen and may heuristically adjust the exertion level or weight setting upward for the user for the next exercise activity set using the same targeted muscle group.

[0141] To help the user conceptualize how his or her exercise rep times vary across an exercise activity set (i.e., how much the rep completion times slow over a given set), the portable computing device 100C includes a Repetition Versus Time Graphing Feature as shown in FIGS. 5, 6 and 7 in which each completed repetition of an exercise activity is graphed visually versus time upon a screen 25 of the portable computing device 100C. In this way, a user may quickly review his or her performance in a full set of an exercise regimen by viewing his or her progress through the exercise activity set in terms of repetitions versus time.

[0142] This graphical format is useful because the changing slope of the curve indicates the ease or difficulty at which the user performed the task. For example, a linear curve indicates that the user performed each repetition in the exercise activity set with similar time interval spacing. This indicates the set was performed with ease.

[0143] A non-linear curve, for example, in which the time spacing between repetitions increases over the exercise activity set, indicates that the user did not perform the set with ease. The set was sufficiently difficult that the user struggled more and more with each passing repetition. In this way, a visual graph of repetitions versus time provides the user with a fast and easy to understand measure of performance in a repetitive exercise activity set such as weight lifting or calisthenics. Such graphing may allow the user to manually adjust the required weight levels (or setting levels) and/or rep counts in future exercise activity sets based upon how hard or easy previous sets were to complete.

In addition, the graphing functions may enable multiple graphed sets to be displayed at once, allowing a user to compare performance in one exercise activity set against another exercise activity set as is shown in FIGS. 7A, 7B.

[0144] Another graphical function includes a Power-Per-Rep Graphing Feature as is shown in FIG. 8 graphically displays the relative power output of the user for each repetition across a set of repetitions for a given exercise activity set. The power may be computed as a normalized value, relative value, or percentage of a target value that reflects the power output of one repetition as compared to other repetitions. By graphing the power output versus repetitions, a user may quickly review how his or her power output varied across an exercise activity set, repetition by repetition. Since power is a function of both acceleration and repetition times, this performance metric provides additional insight into exercise performance, particularly for weight lifting exercise activities. For example, weight lifters generally desire to perform a set of repetitions with minimal power reduction across sets. In this way, the power graph is a valuable indication of performance.

[0145] The portable computing device 100C may also be programmed to provide an exercise rep-time prompting feature in which the user is notified when his or her rep completion times are falling outside of a desired tolerance range. More specifically, the exercise rep-time prompting feature may inform the user during a set if his or her most recent rep completion time was faster than a set maximum rep-time threshold tolerance level or slower than a set minimum rep-time threshold tolerance level.

[0146] This programmatic feature is particularly useful for certain types of weight training regimens in which the user attempts to perform weight lifting repetitions within certain desired repetition times. For example, there are some forms of weight training where the users attempts to raise and lower the weights very slowly. To support such an exercise activity, a low maximum rep-time threshold tolerance level may be set by the user and monitored by the portable computing device 100C.

[0147] If the user completes a rep that is faster than the set maximum rep-time threshold tolerance level, the user is alerted by the portable computing device 100C that he or she has performed a rep too quickly. The prompt may be an intuitive verbal message such as “slow down” or “too fast,” thereby informing the user that he or she should slow down his or her weight lifting reps to stay within the desired rep-time limits.

[0148] Similarly, if a user performs a rep more slowly than a minimum rep-time threshold level, the user is alerted by the portable computing device 100C to speed up by providing a verbal utterance “speed up” or “too slow” to the user through an audio output. In this way, the programmatic features monitor the user’s rep-times and inform the user upon completion of a rep that is faster or slower than set maximum or minimum rep-time limits, to slow down or speed up their rep times accordingly.

[0149] In some exemplary embodiments, the portable computing device 100C may also be programmed to monitor the total time duration required to complete a current exercise activity (i.e. the exercise interval time) and/or monitor the elapsed period of rest between required exercise activities (i.e. the rest interval time.) The exercise interval time and/or the rest interval time may also be used to assess a user performance in a given exercise regimen. As a user proceeds through a current exercise activity, the portable computing device 100C may be configured to audibly and/or visually output the current cumulative count after each completed repetition. In this way, the user of the personal computing device 100C is informed as to the number of repetitions thus far performed in the current exercise activity.

[0150] In addition, the portable computing device 100C may be programmed to inform the user as to the nature of the next required exercise activity set using an audible output. For example, a synthesized voice may issue a prompt such as “Next up, bench press — 50 pounds, 12 reps.” In this way, a user is fully informed as to the next required exercise activity set of the regimen without needing to look at a screen. The prompt may also be visually displayed upon the screen 25 as a textual message.
Upon completion of an exercise activity set, the portable computing device 100C may also be programmed to output a verbal phrase of encouragement such as “good job” or “good set.”

Lastly, in various exemplary embodiments, one or more exercise activity sets listed within a predefined exercise regimen may be associated with one or more musical media files. As such, when a particular exercise activity set is performed, an associated musical media file may be played to the user. In this way, a user may define a listing of musical media files that play, at least in part, based upon which exercise activity set within a pre-planned series of exercise activity sets, the user is currently engaged in. Thus, a user may select particular musical media files that he or she enjoys listening to for example during sit ups and associate these musical media files with sit up exercise activity sets.

The foregoing described of exemplary embodiments is provided as illustrations and descriptions. They are not intended to limit any one exemplary embodiment to the precise forms described. In particular, it is contemplated that functional implementation of an exemplary embodiment described herein may be implemented equivalently in hardware, software, firmware, and/or other available functional components or building blocks. No specific limitation is intended to a particular device or programmatic sequence. Other variations and embodiments are possible in light of teachings, and it is not intended that this Detailed Description limit the scope of invention.

What is claimed:

1. A computer implemented method for orchestrating an exercise regimen using a portable computing device, the method comprising:
   accessing an exercise regimen from a datastore, the exercise regimen comprising a plurality of stationary exercise activity sets, each of the plurality of stationary exercise activity sets including a prescribed exercise type and a prescribed number of exercise repetitions to be performed by a user of the prescribed exercise type; automatically selecting a stationary exercise activity set from the accessed exercise regimen; prompting the user to perform the selected exercise activity set via a user interface associated with the portable computing device; receiving time varying motion signals from at least one acceleration sensor in dependence on the user performing the selected exercise activity set; determining each of a plurality of exercise repetition events from the received motion signals; determining a cumulative repetition count for the selected exercise activity set from the determined exercise repetition events; storing exercise performance data for the selected exercise activity set, the performance data including at least one time value associated with each of a plurality of determined exercise repetition events; and notifying the user via the user interface when the determined cumulative repetition count has achieved the prescribed number of exercise repetitions for the selected exercise activity.

2. The computer implemented method according to claim 1 wherein the stored performance data further includes at least one power value associated with each of a plurality of determined exercise repetitions events of the selected exercise activity set.

3. The computer implemented method according to claim 1 further comprises prompting the user via the user interface as to a prescribed weight level to be used during the selected exercise activity set.

4. The computer implemented method according to claim 1 further comprising sequentially selecting another stationary exercise activity set from the exercise regimen upon completion or deferral of the selected exercise activity set.

5. The computer implemented method according to claim 1 wherein each of the plurality of exercise activity sets further comprises a prescribed rest period value.

6. The computer implemented method according to claim 1 further comprising prompting the user when a predefined rest period has expired or is about to expire.

7. The computer implemented method according to claim 1 further comprising automatically modifying an exercise regimen in dependence on the stored exercise performance data.

8. The computer implemented method according to claim 1 further comprising receiving a user input representing a deferral of the sequentially selected exercise activity set.

9. The computer implemented method according to claim 1 further comprising recording an indicia representing that the sequentially selected exercise activity set was deferred.

10. The computer implemented method according to claim 8 further comprising prompting the user to perform the deferred exercise activity set at a later time.

11. The computer implemented method according to claim 1 further comprising outputting to the user interface, a graphical representation of the user’s completed exercise activity set, the graphical representation including a plot of exercise repetition events versus time.

12. The computer implemented method according to claim 2 further comprising outputting a graphical representation of the user’s completed exercise activity set, the graphical representation including a plot of power output values versus repetition count.

13. The computer implemented method according to claim 1 wherein each of the plurality of stationary exercise activity sets further comprises a group identifier.

14. The computer implemented method according to claim 13 wherein each exercise activity set that targets a common muscle group is assigned a common group identifier.

15. The computer implemented method according to claim 13 wherein each exercise activity set that uses the same piece of exercise equipment is assigned a common group identifier.

16. The computer implemented method according to claim 2 further comprising determining a deceleration metric for the exercise repetition events performed by the user during the selected exercise activity set.

17. The computer implemented method according to claim 1 further comprising prompting the user via the user interface as to which body part the acceleration sensor should be affixed to for the selected exercise activity set.

18. The computer implemented method according to claim 17 wherein the acceleration sensor is affixed to the wrist of the user.

19. The computer implemented method according to claim 1 wherein each of a plurality of sequential exercise activity sets is associated with the same prescribed exercise type.
20. A portable computing device for orchestrating an exercise regimen comprising:

- a processor;
- a user interface coupled to the processor for receiving user inputs and outputting exercise information to a user;
- an acceleration sensor coupled to the processor, the acceleration sensor generating time dependent motion signals in response to the user’s performance of stationary exercise activities;
- a computer readable storage medium comprising a datastore coupled to the processor comprising having programmatic instructions stored therein which when executed by the processor, causes the processor to:
  - access an exercise regimen from the datastore, the exercise regimen including a plurality of stationary exercise activity sets, each of the plurality of stationary exercise activity sets including a prescribed exercise type and a prescribed number of exercise repetitions to be performed by the user of the prescribed exercise type; and
  - automatically select a stationary exercise activity set from the accessed exercise regimen;
- prompt the user to perform the selected exercise activity via the user interface;
- receive time varying motion signals from the acceleration sensor in dependence on the user performing the selected exercise activity set;
- determine each of a plurality of exercise repetition events from the received motion signals;
- determine a cumulative repetition count for the selected exercise activity set from the determined exercise repetition events;
- store exercise performance data in the datastore for the selected exercise activity set, the stored performance data including at least one time value associated with each of a plurality of determined exercise repetition events; and
- notify the user via the user interface when the determined cumulative repetition count has achieved the prescribed number of exercise repetitions for the selected exercise activity.

21. The portable computing device according to claim 20 wherein the stored exercise performance data further comprises at least one power value associated with each of a plurality of determined exercise repetition events of the selected exercise activity set.

22. The portable computing device according to claim 20 further comprising programmatic instructions which when executed by the processor, causes the processor to prompt the user via the user interface with a prescribed weight level to be used during the selected exercise activity set.

23. The portable computing device according to claim 20 further comprising programmatic instructions which when executed by the processor, causes the processor to sequentially select another stationary exercise activity set from the exercise regimen upon completion or deferral of the selected exercise activity set.

24. The portable computing device according to claim 20 wherein each of the plurality of exercise activity sets further comprises a prescribed rest period value.

25. The portable computing device according to claim 24 further comprising programmatic instructions which when executed by the processor, causes the processor to prompt the user via the user interface when a predefined rest period has expired or is about to expire.

26. The portable computing device according to claim 20 further comprising programmatic instructions which when executed by the processor, causes the processor to automatically modify an exercise regimen in dependence on the stored exercise performance data.

27. The portable computing device according to claim 23 further comprising programmatic instructions which when executed by the processor, causes the processor to receive a user input representing a deferral of the sequentially selected exercise activity set.

28. The portable computing device according to claim 27 further comprising programmatic instructions which when executed by the processor, causes the processor to store an indication in the datastore representing that the sequentially selected exercise activity was deferred.

29. The portable computing device according to claim 27 further comprising programmatic instructions which when executed by the processor, causes the processor to prompt the user to perform the deferred exercise activity set at a later time.

30. The portable computing device according to claim 20 further comprising programmatic instructions which when executed by the processor, causes the processor to output to the user interface, a graphical representation of the user’s completed exercise activity set, the graphical representation comprising a plot of exercise repetition events versus time.

31. The portable computing device according to claim 20 further comprising programmatic instructions which when executed by the processor, causes the processor to output a graphical representation of the user’s completed exercise activity set, the graphical representation comprising a plot of power output versus repetition count.

32. The portable computing device according to claim 20 wherein each of the plurality of stationary exercise activity sets further comprises a group identifier.

33. The portable computing device according to claim 32 wherein each exercise activity set that targets a common muscle group is assigned a common group identifier.

34. The portable computing device according to claim 32 wherein each exercise activity set that uses common exercise equipment is assigned a common group identifier.

35. The portable computing device according to claim 20 further comprising programmatic instructions which when executed by the processor, causes the processor to determine a deceleration metric for the exercise repetition events preformed by the user during the selected exercise activity set.

36. The portable computing device according to claim 20 further comprising programmatic instructions which when executed by the processor, causes the processor to prompt the user via the user interface with a body part in which the acceleration sensor is to be affixed for the selected exercise activity.

37. The portable computing device according to claim 36 wherein the acceleration sensor is affixed to the wrist of the user.

38. The portable computing device according to claim 20 wherein each of a plurality of sequential exercise activity sets is associated with a common prescribed exercise type.

39. A portable computing system for orchestrating an exercise regimen comprising:

- a wireless sensor unit, the wireless sensor unit including an motion sensor and a wireless communication link; and
- the motion sensor configured to generate time depen-
dent motion signals in response to a user's performance of stationary exercise activities; a portable computer comprising a processor, a user interface, a wireless communication link for receiving signals from the wireless sensor unit; a computer readable storage medium comprising a datastore coupled to the processor comprising having programmatic instructions stored therein which when executed by the processor, causes the processor to; access an exercise regimen from the datastore, the exercise regimen including a plurality of stationary exercise activity sets, each of the plurality of stationary exercise activity sets including a prescribed exercise type and a prescribed number of exercise repetitions to be performed by a user of the prescribed exercise type; select a stationary exercise activity set from the accessed exercise regimen; prompt the user to perform the selected exercise activity set via the user interface; receive signals from the wireless sensor unit in dependence on the user performing the selected exercise activity set; identify each of a plurality of exercise repetition events from the received signals; determine a cumulative repetition count for the selected exercise activity set from the identified exercise repetition events; store exercise performance data for the selected exercise activity set in the datastore, the stored performance data including at least one time value associated with each of a plurality of identified exercise repetition events; and notify the user via the user interface when the determined cumulative repetition count has achieved the prescribed number of exercise repetitions for the selected exercise activity set.

40. The portable computing system according to claim 39 wherein the wireless sensor unit is worn on a wrist of the user.

* * * * *