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(54) METHOD AND APPARATUS FOR PRECISION PACING

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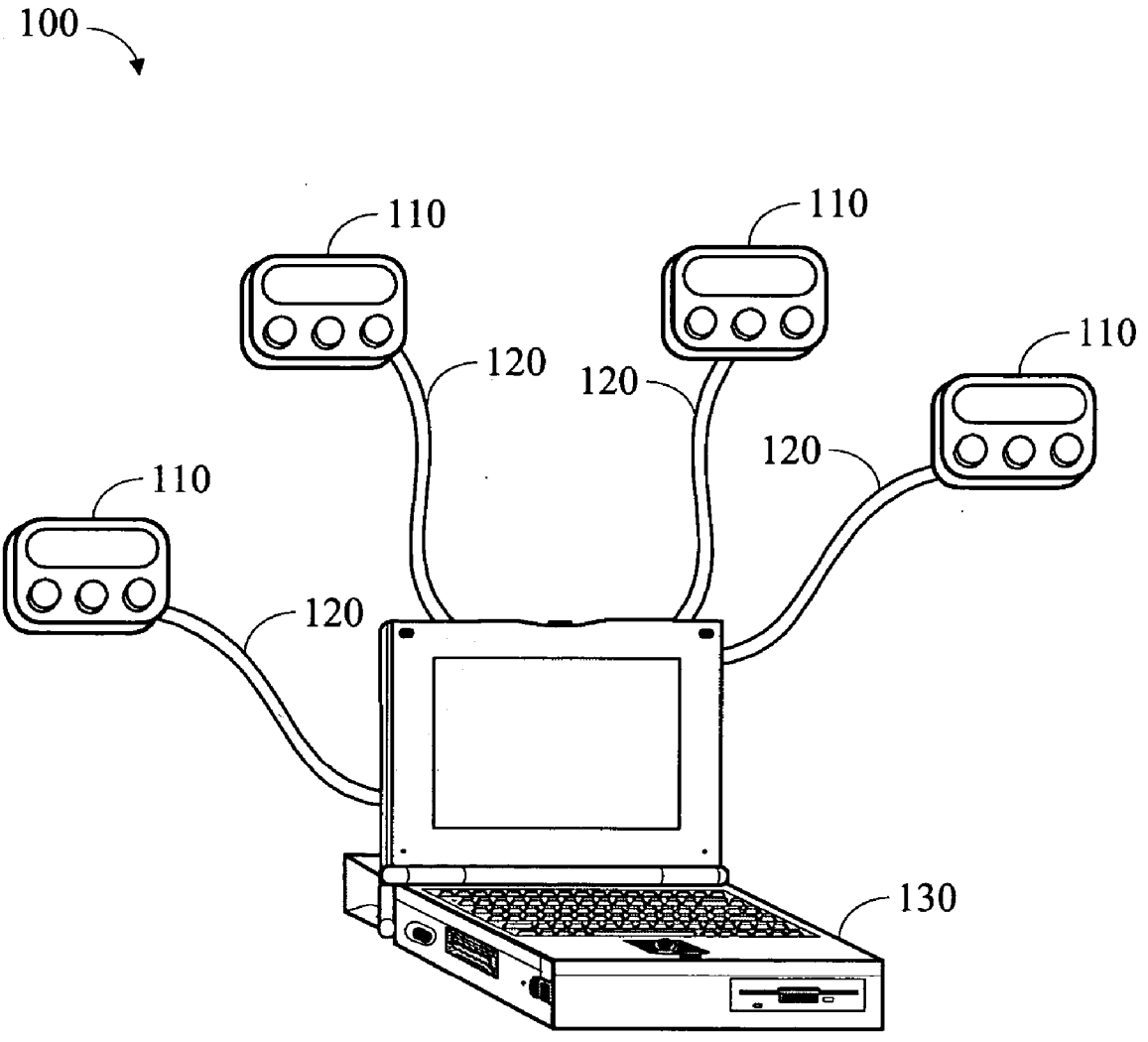
(57) ABSTRACT

An improved apparatus and method for enhanced training based on variable pacing includes the division of a training course into a series of segments. Each of the segments has an associated length and duration. An associated pacing unit is programmed to output an audio and/or tactile and/or a visual signal for a pre-determined pace to be maintained for each of the segments for a given event. By repetitively using the pacing unit during training sessions, an athlete can learn the appropriate pace to maximize performance for a given event.



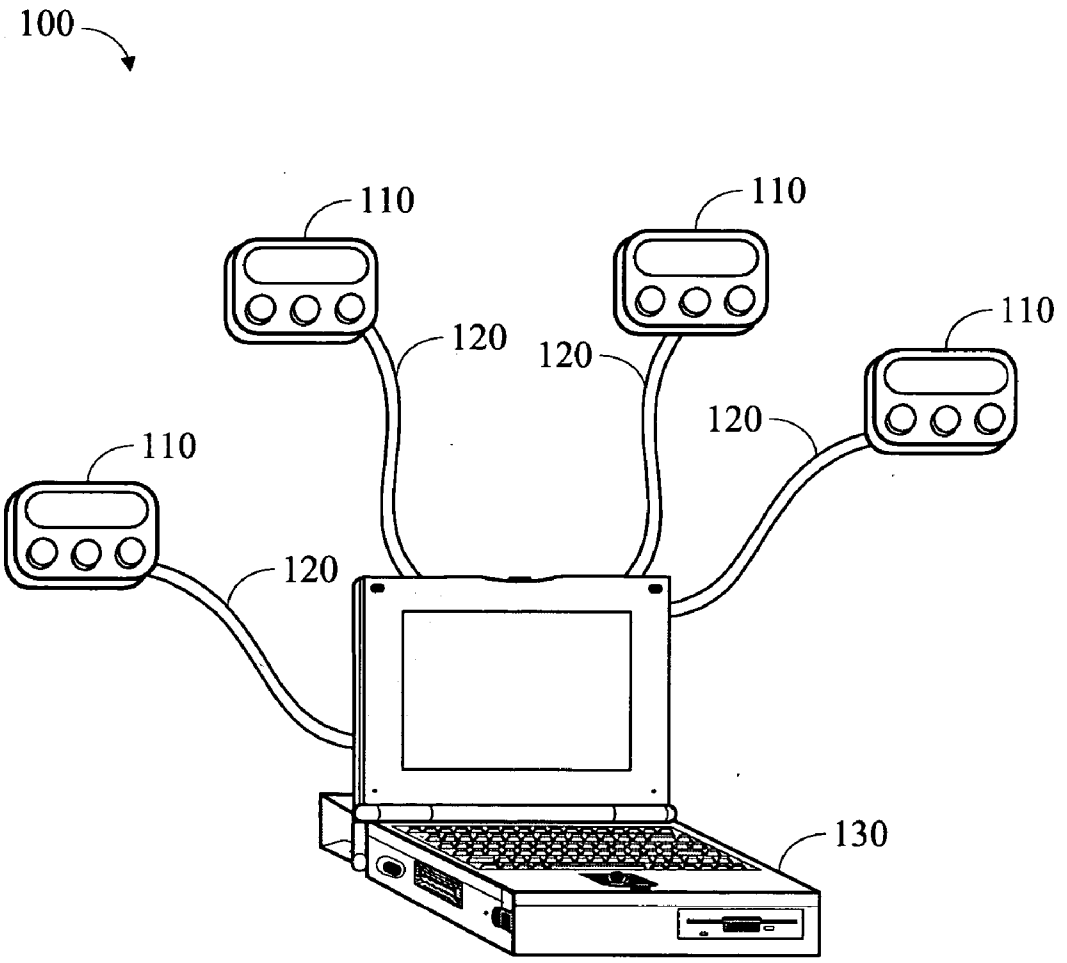


FIG. 1

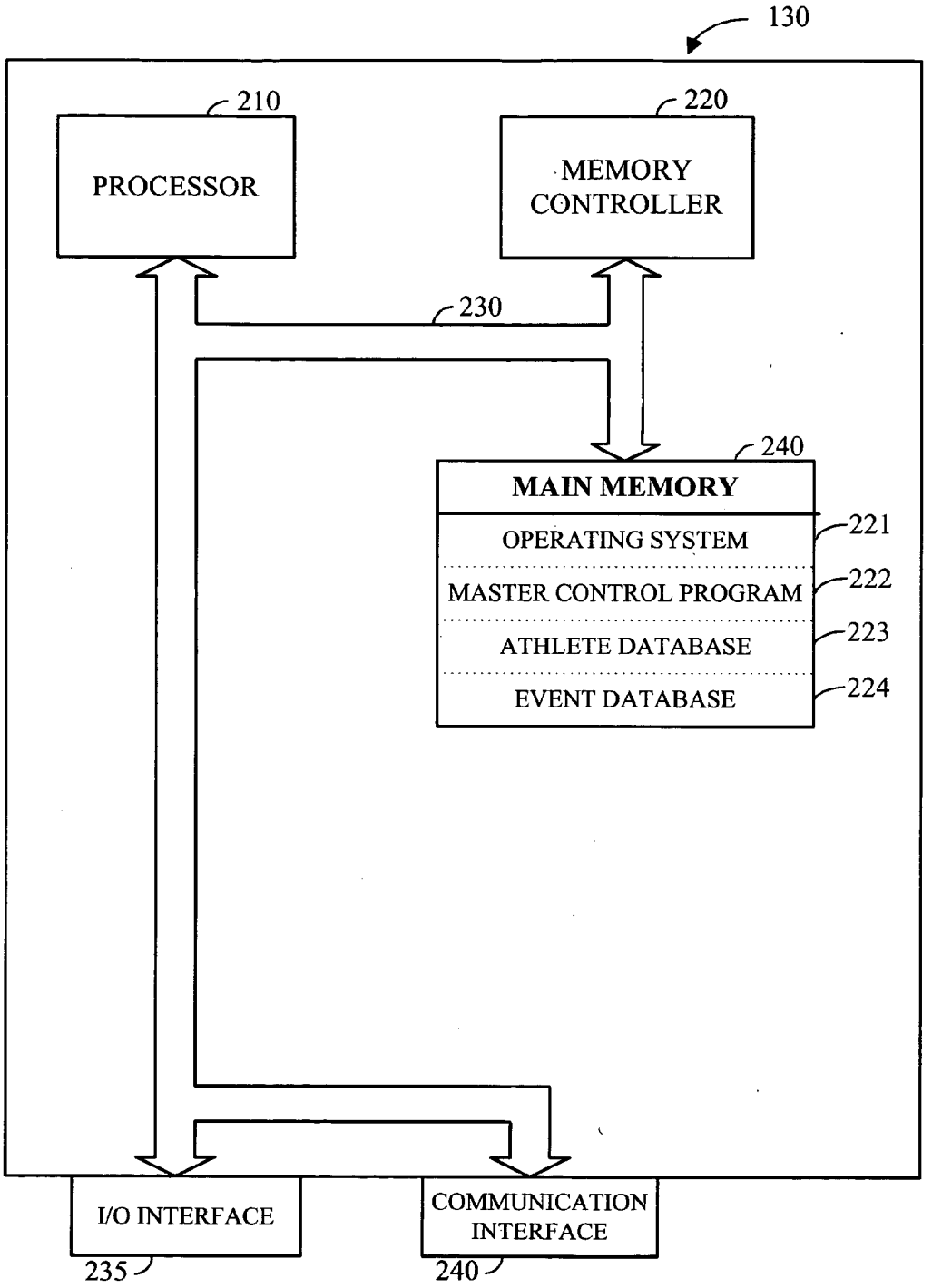

130
210
PROCESSOR
220
MEMORY CONTROLLER
230
240
MAIN MEMORY
OPERATING SYSTEM
221
MASTER CONTROL PROGRAM
222
ATHLETE DATABASE
223
EVENT DATABASE
224
I/O INTERFACE
235
COMMUNICATION INTERFACE
240

FIG. 2

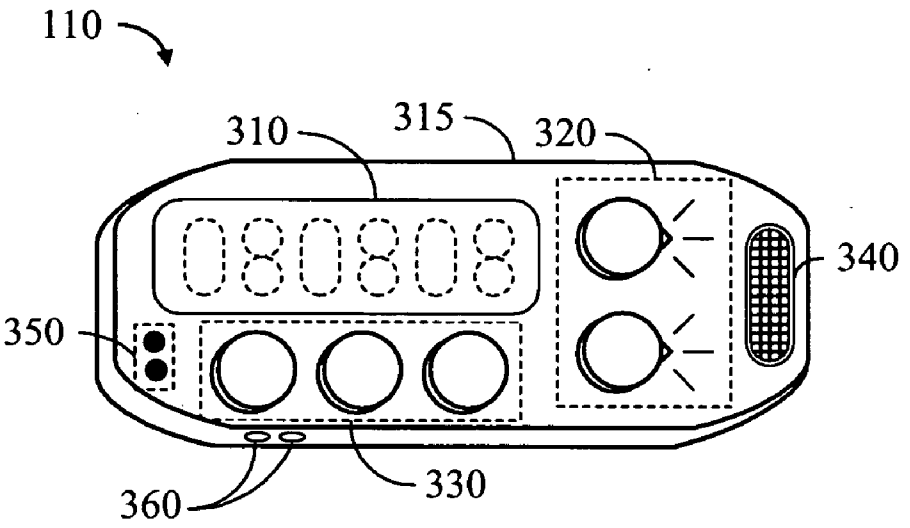

110
310
315
320
080808
340
350
360
330

FIG. 3

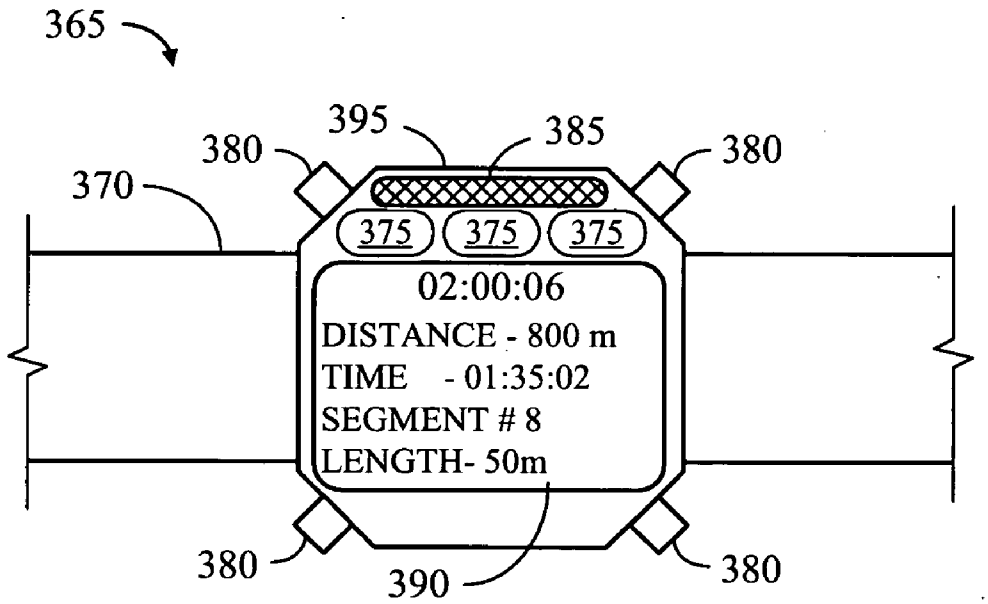

365
395
385
380
380
370
375
375
375
02:00:06
DISTANCE - 800 m
TIME - 01:35:02
SEGMENT # 8
LENGTH- 50m
380
390
380

FIG. 3A

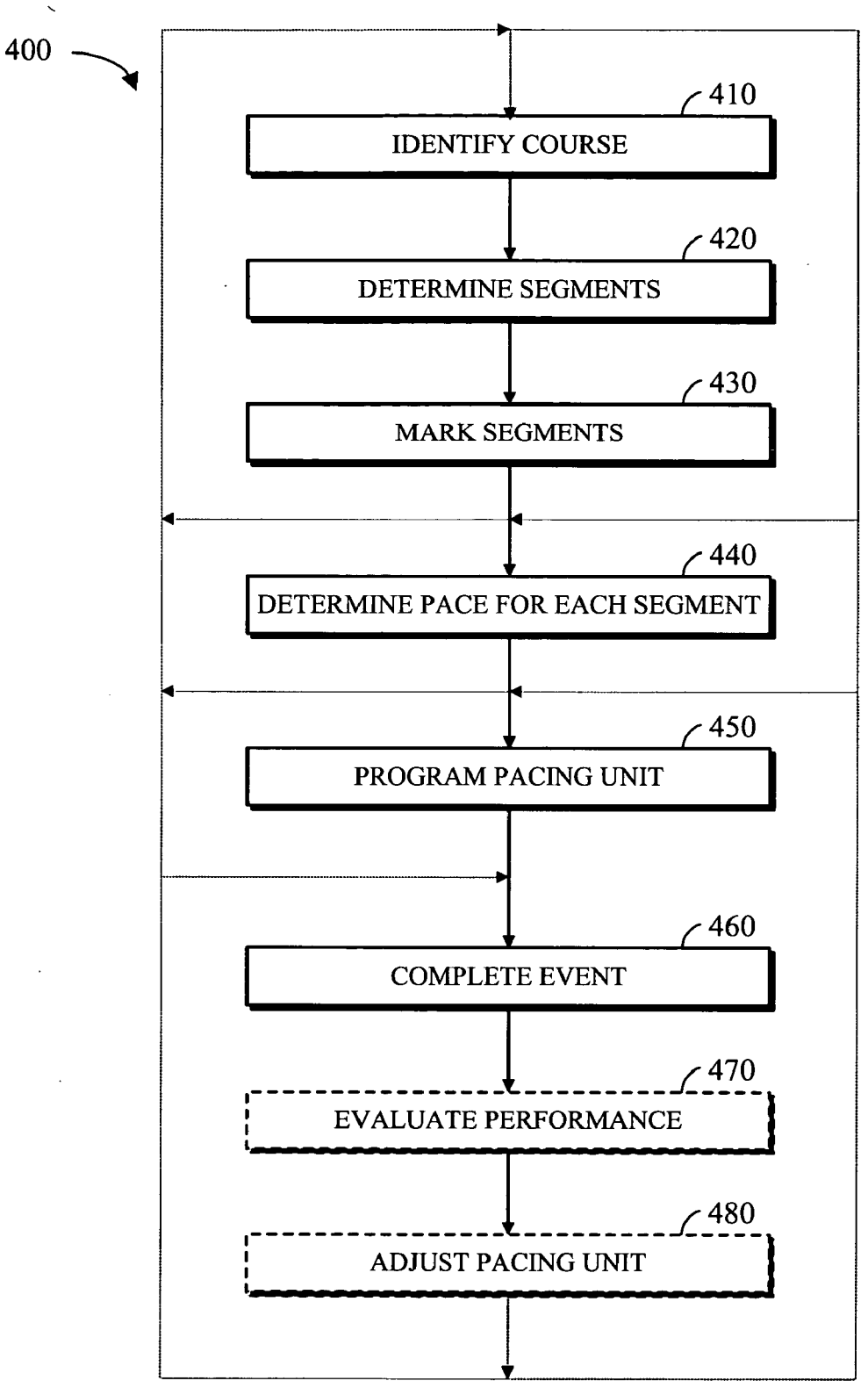

400
410
IDENTIFY COURSE
420
DETERMINE SEGMENTS
430
MARK SEGMENTS
440
DETERMINE PACE FOR EACH SEGMENT
450
PROGRAM PACING UNIT
460
COMPLETE EVENT
470
EVALUATE PERFORMANCE
480
ADJUST PACING UNIT

FIG. 4

METHOD AND APPARATUS FOR PRECISION PACING

TECHNICAL FIELD

[0001] The present invention relates generally to programmable electronic devices and more particularly to an improved apparatus and method for training athletes for enhanced competitive performance.

BACKGROUND OF THE INVENTION

[0002] Competitive athletes face many challenges in developing and perfecting their training regimen to achieve optimal athletic performance. Success is invariably the combined result of proper diet, exercise, practice, rest, coaching, mental preparation, and other similar factors. Of these, the significance of proper practice may be the least understood. While the old axiom, "practice makes perfect" is frequently repeated, it is only true to a limited extent. It may be more appropriate to say, "Perfect practice makes perfect." Even with this communicated understanding, as with most worthwhile and difficult endeavors, it is still easier said than done.

[0003] Nowhere is this more evident in the world of competitive sports than it is in the cardiovascular intensive fields of running, swimming, speed skating and other similar events that require constant improvement in a highly competitive environment. For athletes competing in these sports, proper pacing is typically the answer to ultimate success. If an athlete can learn how to properly pace their performance, accurately matching the level of energy expenditure to the demands of the event, success can be attained. By learning and implementing a proper pacing during practice sessions, athletes can prepare for competition and be assured of maximum performance. Unfortunately, the development and implementation of proper pacing techniques is extremely difficult for even the best of athletes.

[0004] For example, the most common problems in the optimal performance of athletes such as runners, swimmers and the like are typically the result of "under pacing,""over pacing," or "fluctuating pace." Each of these situations may be problematic from a training standpoint and can serve to hamper an athlete's ability to perform at the highest levels.

[0005] Over pacing occurs when, for example, a runner is running too quickly or at a pace beyond the runner's ability for a given distance. Over pacing will cause the runner to use up their energy reserves too quickly and to experience the debilitating effects of "oxygen debt." Oxygen debt is a condition that occurs when the body enters into an anaerobic state during athletic performance. Anaerobic means "without oxygen." During anaerobic work, involving maximum effort, the body is working so hard that the demands for oxygen and fuel exceed the rate of supply and the muscles have to rely on the stored reserves of fuel. In this case waste products accumulate in the muscle tissue with the chief waste product being lactic acid. The body's stored fuel soon runs out and activity ceases, many times in a fairly painful way. Activity may not be effectively resumed until the lactic acid is removed and the oxygen debt repaid.

[0006] Under pacing is substantially the opposite of over pacing and occurs when the runner fails to exert enough energy to perform at the appropriate level. Under pacing is detrimental because a fairly precise level of effort is required to achieve adequate training effect. When an athlete fails to perform at a high enough level, then the training experience is sub-optimal and the desired increase in ability does not take place in the training environment. Accordingly, the athlete will fail to improve their performance and execute at the highest possible level in actual competition.

[0007] Fluctuating pace is a situation where an athlete continually alternates between over pacing and under pacing. This constant change in the pace is generally considered quite detrimental from a training standpoint and is also an inefficient use of body fuel. The end result of fluctuating pace is not too dissimilar from the erratic speed of an automobile being driven by an unskilled driver, leading to lack of performance and lack of economy in the performance of the automobile. Similarly, an athlete using a fluctuating pace will typically not perform at the optimal level and will consume precious fuel in inefficient movements. While generally undesirable, fluctuating pace can be used by highly trained athletes as a racing tactic. However, if this tactic is to be employed, a significant amount of training in this tactic is generally desired to ensure effectiveness. Given the physical difficulty associated with this type of training, most athletes do not practice this method on a frequent basis.

[0008] Efficient pace control is an essential element in many different sports, and at many different distances. The longer the race, the more important pace control can become. The precise amount of fuel to be expended at each stage of the race must be understood and the athlete must execute on a pace control strategy in order to be successful. Additionally, in some competitions, the athlete cannot see the other competitors and must learn to control their own pace so as to reach the optimal level of performance. Once again, this is a fairly straightforward concept to grasp, but an exceedingly difficult one to implement.

[0009] While there are certain pacing devices available for training athletes, they tend to provide a "metronome-like" cadence that is not suitable for the ever-changing level of performance demanded during the heat of most competitions. Many of the known pacing devices simply set a pace calculated by dividing a given distance by the desired time for covering the distance, thereby yielding a certain number of steps for a given athlete's stride to cover the proposed distance. Other pacing devices are employed to provide a training regimen by measuring the stride or arm swing of an athlete in real time and providing biofeedback if the measured stride is not within the training limits. While useful to some degree, none of these approaches considers the practical need for pace training outside of these very narrowly defined constraints. Additionally, rhythmic pacing devices can be ineffective and/or inaccurate due to variables such as stride variations during training sessions, changing terrain, inclement weather, etc.

[0010] As can be seen by the discussion presented above, in spite of previous attempts to provide devices and techniques for improved pacing, there is still a need for an improved pace training apparatus and method. Otherwise, competitive performance for many athletes will continue to be suboptimal.

BRIEF SUMMARY OF THE INVENTION

[0011] The present invention provides an apparatus and method for enhanced training. The method of training

includes the identification of a training course and the division of the training course into a series of segments. Each of the segments has an associated length and duration. An associated pacing unit is programmed to output an audio and/or a visual signal for a pre-determined pace to be maintained for each of the segments for a given event. By repetitively using the pacing unit during training sessions, an athlete can learn the appropriate pace to maximize performance for a given event.

BRIEF DESCRIPTION OF THE DRAWINGS

[0012] The preferred embodiments of the present invention will hereinafter be described in conjunction with the appended drawings, wherein like designations denote like elements, and:

[0013] **FIG. 1** is a block diagram of a training apparatus, including a plurality of pacing devices, in accordance with a preferred embodiment of the present invention;

[0014] **FIG. 2** is a block diagram of the computer system of **FIG. 1**;

[0015] **FIG. 3** is a schematic representation of a pacing unit **110** of **FIG. 1** in accordance with a preferred embodiment of the present invention;

[0016] **FIG. 3A** is a schematic representation of an alternative embodiment of a pacing unit in accordance with a preferred embodiment of the present invention; and

[0017] **FIG. 4** is a flow chart of a training method **400** in accordance with a preferred exemplary embodiment of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0018] The present invention provides an apparatus and method for calculating and outputting an audio and/or a visual and/or tactile indicator, thereby transmitting a specific series of pacing signals or instructions for a given athlete for a pre-determined series of segments for a given event. By repetitively using the output of the pacing device during training sessions, an athlete can learn the appropriate pace to maximize training and performance for a given event. For the purpose of illustration, the present invention will hereinafter be described in the context of a runner training for a race or running in a race. However, those skilled in the art will recognize that the principles described in conjunction with the various preferred embodiments are easily adapted for other sports such as swimming, speed skating, and the like.

[0019] Referring now to **FIG. 1**, a training apparatus **100** in accordance with a preferred embodiment of the present invention comprises: a computer **130**; at least one pacing unit **110**; and a communication medium **120** logically connecting each pacing unit **110** to computer **130**. Pacing unit **110** is representative of an apparatus used by an athlete for the purpose of learning the appropriate pace for a given competition. Communication medium **120** is representative of a communication connection between pacing units **110** and computer **130** for transmitting data between pacing units **110** and computer **130**. Communication medium **120** may be a physical connection effectuated via a wire or cable or simply a logical connection in a wireless configuration. In certain preferred embodiments of the present invention, such as a universal serial bus (USB) connection, communication medium **120** may also include a power signal. Computer **130** is merely representative of many different electronic computing devices that may be suitably used in the various preferred embodiments of the present invention.

[0020] In the most preferred embodiments of the present invention, each athlete will have a pacing unit **110** to provide pacing instruction during training sessions. Computer **130** functions as a master control unit, storing information related to each athletes training regimen and performance goals. Additionally, in certain preferred embodiments of the present invention, each pacing unit **110** is configured to receive training session-related data from the athlete during and/or after the training session. This data may include data such as the actual pace versus pre-planned pace for the activity. In these embodiments, computer **130** may receive the stored data from each pacing unit **110** at the end of an athlete's training session. This session-related data may be accumulated over time and used to adjust or "fine tune" each individual athlete's performance, thereby allowing for periodic improvement based on the enhanced training opportunities provided from using a pacing unit **110**. While the use of pacing unit **110** is hereinafter described in conjunction with computer **130** and communication medium **120**, each pacing unit **110** is a capable of independent, stand-alone use. Training apparatus **100**, in its entirety, is preferred for team training and more sophisticated competition environments. Each of the components in **FIG. 1** is explained more fully below in conjunction with the remaining figures.

[0021] In the most preferred embodiments of the present invention, computer **130** acts a master unit and can be used to program each pacing unit **110**. In this operational mode, computer **130** communicates with pacing units **110** via communication medium **120** and sends pace training-related data to each pacing unit **110** for the athlete that will be using that specific pacing unit **110**. Communication medium **120** is representative of any type of logical connection and/or physical communication mechanism known to those skilled in the art, regardless or protocol or standard, including proprietary standards in addition to various well-known standard computer serial and/or parallel communication technologies. The actual communication connection between pacing units **110** and computer **130** may include one or more of the following: a physical connection such as a USB connection; a firewire connection; an RS-232 connection or the like. Alternatively, in certain preferred embodiments of the present invention, communication medium **120** may represent a wireless communication protocol via radio frequency, infrared communication and/or Bluetooth connectivity protocols. Pacing unit **110** may be configured to communicate with computer **130** via any or all of these methods and in at least one preferred embodiment of the present invention, multiple redundant means for communication between pacing units **110** and computer **130** may be employed. When communication medium **120** provides a power signal, each pacing unit may be recharged via communication medium **120**. In this case, a power supply associated with computer **130** may provide the power source for recharging pacing units **110**.

[0022] Referring now to **FIG. 2**, computer **130** suitably comprises at least one Central Processing Unit (CPU) or processor **210**, a main memory **240**, a memory controller

230, an I/O interface **235**, and a communication interface **240**, all of which are interconnected via an internal system bus **230**. As previously mentioned, computer **130** is depicted as a laptop computer but may be implemented by alternative means. For example, computer **130** may be a general-purpose laptop computer, a personal digital assistant (PDA), or some other type of special purpose computing device, designed specifically to be used in conjunction with the various preferred embodiments of the present invention. Specifically, it is envisioned that a hand-held computer or palm-based computing device may perform all or substantially all of the functions described in conjunction with computer **130**.

[**0023**] Additionally, it should be noted that various modifications, additions, or deletions may be made to computer **130** as illustrated in **FIG. 2** within the scope of the present invention such as the addition of cache memory or other peripheral devices. For example, computer **130** may also include a standalone CRT monitor or other display device (not shown) connected to the system bus **230**. Alternatively, it is anticipated that computer **130** may be a terminal without a CPU that is connected, in turn, to a network as a network computer (NC). In that case, the responsibilities and functions of CPU **210** may be assumed and performed by some other device on the network. **FIG. 2** is not an exhaustive illustration of any specific computer system or configuration, but is presented to simply illustrate some of the salient features of one preferred embodiment for computer **130**.

[**0024**] Processor **210** performs the computation and control functions of computer **130** and may comprise a single integrated circuit, such as a microprocessor, or may comprise any suitable number of integrated circuit devices and/or circuit boards working in cooperation to accomplish the functions of a processor. Processor **210** typically executes and operates under the control of an operating system **221** within main memory **240**. Operating system **221** may be any suitable operating system known to those skilled in the art.

[**0025**] I/O interface **235** allows computer **130** to store and retrieve information from various external sources such as hard disk drives and other Direct Access Storage Devices (DASD). It is important to note that while the present invention has been (and will continue to be) to be described in the context of a fully functional computer system, those skilled in the art will appreciate that the various mechanisms of the present invention are capable of being distributed as a program product in a variety of forms, and that the present invention applies equally regardless of the particular type or location of signal to control the apparatus. I/O interface **235** may be a single bus configuration or employ multiple computer bus structures, including related hardware such as various physical connectors used to attach various peripheral devices such as printers, keyboards, monitors, trackballs, etc. to computer **130**. Additionally, I/O interface **235** may communicate via serial or parallel presentation of the data using any type of communication protocol and physical connection, including firewire, RS-232, Universal Serial Bus (USB) or any other standard connection means now known or later developed by those skilled in the art.

[**0026**] Interface **245** is a communication connection interface for logically and/or physically connecting pacing units **110** and devices to computer **130**. Although shown as a single interface, interface **245** may actually be a combination of interface connections, each with a separate connection to bus **230**. Interface **245** represents any physical and/or logical means for connecting pacing units **110** with computer **130** in order to provide for communication between pacing units **110** and computer **130**. In the most preferred embodiments of the present invention, interface **245** provides for bi-directional communications. In certain less preferred embodiments of the present invention, interface **245** may be a unidirectional communication path.

[**0027**] Memory controller **220**, through use of a processor (not shown) separate from processor **210**, is responsible for moving requested information from main memory **240** and/or through I/O interface **235** to processor **210**. While for the purposes of explanation, memory controller **230** is shown as a separate component; those skilled in the art understand that, in practice, portions of the function provided by memory controller **230** may actually reside in the circuitry associated with processor **210**, main memory **240**, and/or I/O interface **235**.

[**0028**] Although computer **130** depicted in **FIG. 2** contains only a single main processor **210** and a single system bus **230**, it should be understood that the present invention applies equally to computer systems having multiple processors and/or multiple system buses. Similarly, although system bus **230** of the preferred embodiment is a typical hardwired, multi-drop bus, any connection means that supports bi-directional communication in a computer-related environment could be used, including wireless communication means.

[**0029**] Main memory **240** suitably preferably contains at least an operating system **221**. The term "memory" as used herein refers to any storage location in the virtual memory space of computer **130**. It should be understood that main memory **240** may not necessarily contain all parts of all mechanisms shown and may contain additional mechanisms as well. For example, portions of operating system **221** may be loaded into an instruction cache (not shown) for processor **210** to execute, while other related files and programs may well be stored on magnetic or optical disk storage devices (not shown) but connected via I/O interface **235**. Similarly, it is possible to program main memory **224** with a series of standard race tables containing information relative to intermediate racing times, split times, etc. for different types of races. In addition, although shown as a single memory structure, it is to be understood that main memory **240** may consist of multiple disparate memory locations.

[**0030**] Operating system **221** typically includes the software that is used to operate and control computer **130**. Operating system **221** may be a single program or, alternatively, a collection of multiple programs, which act in concert to perform the functions of any typical operating system, which functions are well known to those skilled in the art.

[**0031**] Master control program **222** is the overall control program for controlling pacing units **110**. Master control program **222** communicates with pacing units **110** via data sent and received through bus **230** and interface **245**. Master control program **222** is capable of interpreting the various signals received from I/O interface **235** and interface **245**, translating the signals in order to communicate each pacing

unit **110**. Master control program **222** further incorporates a user interface that allows an operator to send instructions via bus **230**, thereby programming each pacing unit **110** individually or in concert. The user may interact with master control program **222** by use of standard computer peripherals such as a video display terminal and keyboard (not shown) that are connected to computer **130** via I/O interface **235**.

[**0032**] Bus **230** is representative of any communication path or medium used to transmit signals and provide communication between the internal components of computer **130** and any external devices or components connected to computer **130** via I/O interface **235** or communication interface **245**. This includes standard serial and parallel bus structures, regardless of the physical topology of the communication path or physical medium used. In at least one preferred embodiment of the present invention, bus **230** is a wireless communication signal.

[**0033**] Athlete database **223** is a database the can track and store the data for each individual athlete using a pacing unit **110**. Athlete database will typically store data such as previous performances, including times, paces, etc. in an individual athlete profile. Split times, current and past training regimens, etc. are all examples of the types of data that may be stored in athlete database **223**. After each athletic event, whether a training exercise or actual performance, the athlete's performance related data for that event may be entered into athletic database **223**. The performance may be entered directly into athlete database **223** manually via master control program **222** or entered into a pacing unit **110** and then transferred to computer **130** and athlete database **223** via communication medium **120**. Additionally, in certain preferred embodiments of the present invention, the performance data may be generated automatically during the event by the use of biofeedback and other related devices and stored in pacing unit **110** for later transmission to computer **130** and athlete database **223**. Athlete database **223** is also capable of storing actual segment times for a given segment or segments. This allows an athlete to evaluate actual performance versus planned performance to measure and report on progress as it occurs.

[**0034**] Event database **224** is a database the stores the data related to each and every event, race, or course that the athlete has attempted or completed as well as additional courses or raced that may be attempted in the future. This information is most preferably stored in a series of event profiles that contains data such as the length of the event, the dates the event was attempted, weather conditions associated with the event and the date, other competitors in the event, etc. The event profile for each event may also include information such as the relative difficulty of the course, the length of various training segments (subdivisions within the course), etc. Each time an athlete attempts or completes an event, the information related to that event may be entered into or updated in event database **224**. By combining the data from athlete database **223** with the data from event database **224**, an athlete's performance for various activities can be predicted, evaluated, and scheduled. Additionally, specific weaknesses in an athlete's performance can be addressed by scheduling additional training sessions or competitions specifically designed to address the given weakness. Additionally, event profiles for future events may be constructed to maximize the desired training effect.

[**0035**] While the various components in main memory **240** are shown as separate programs or components, all of the software components shown in main memory **240**, including master control program **222**, may be combined into a single program product.

[**0036**] Referring now to **FIG. 3**, a pacing unit **110** in accordance with a preferred embodiment of the present invention is depicted. As shown in **FIG. 3**, pacing unit **110** comprises a case or housing **315** that may house some or all of the following components: a display **310**; one or more mode selectors **320**; one or more programming buttons **330**; a speaker **340**; one or more status indicators **350**; and one or more I/O ports **360**.

[**0037**] The electronic and mechanical components of pacing unit **110** are most preferably impact resistant components that are capable of withstanding the rigors of intense athletic training environments. In some preferred embodiments of the present invention, the various components may be waterproof. In the most preferred embodiments of the present invention, pacing unit **110** is incorporated into a wristwatch type device for easy accessibility during training sessions. Alternatively, in other preferred embodiments of the present invention, pacing unit **110** may be integrated into a baseball cap or swimming cap. In the most preferred embodiments of the present invention, pacing unit **110** and the various components contained therein are powered by an internal rechargeable battery unit (not shown this FIG.).

[**0038**] Pacing unit **110** may be any type of portable electronic device capable of storing the pace-related information required to implement the methodology of the present invention. The most preferred embodiments of the present invention will incorporate some or all of the same capabilities of computer **130**. As explained in conjunction with the description of computer **130**, pacing unit **110** will typically include some type of processing unit, associated memory and other supporting electronic components. The athlete profile and event profile may be stored in the memory of pacing unit **110**. In some preferred embodiments of the present invention, all of the functionality of computer **130** as explained in conjunction with **FIG. 2** may be incorporated into each pacing unit **110**. Minimally, pacing unit **110** will be capable of storing and producing the pacing information in a form suitable for use in pace-related training situations and, if desired, during races where the use of such devices is sanctioned. Typically, this will include the information relative to the segments for a given event, including the distance and time duration for each of the segments in the event. From this information, the appropriate pace can be calculated by the processor and output by pacing unit **110**.

[**0039**] Optional display **310** is representative of any typical display commonly employed in portable electronic devices. This includes LCD and LED type displays capable of displaying various types of alphanumeric information. Display **310** may be used to interact with pacing unit **110** during programming and may also provide feedback during pace training sessions.

[**0040**] Optional mode selectors **320** are indicative of the types of switches or dials that may be used to select different types of modes or operating functions of pacing unit **110**. By selecting different modes, pacing unit may be used for multiple types of training sessions and may be interactively configured for different types of pacing output signals,

including various audio and visual outputs. Additionally, mode selectors **320** may be used to provide specific modes for programming pacing unit **110** and for communicating with computer **130**.

[**0041**] Optional programming buttons **330** are indicative of interface mechanisms that can be used to program the functions of pacing unit **110**. While pacing unit **110** may be programmed via computer software stored in computer **130**, pacing unit **110** may also function in a stand-alone mode and may be programmed and operated completely independent from computer **130**. In the most preferred embodiments of the present invention, each pacing unit **110** will be capable of communicating with computer **130** and exchanging data relevant to pacing training sessions prior to each training session and after completion of each training session.

[**0042**] Optional speaker **340** is representative of an optional audio output mechanism that can be used to provide programming feedback as well as pacing information during training sessions. The pacing information may be presented as any type of audio feedback known to those skilled in the art including a tone, a bell, a chime, a series of tones, bells, chimes, etc. Additionally, in certain preferred embodiments of the present invention, various different sounds may be employed to signify the start of a training session or segment, the end of a training session or segment, a rest segment, etc. Speaker **340** may be a waterproof output mechanism for water-related athletic activities or outdoor training where inclement weather may be experienced.

[**0043**] Optional status indicators **350** are indicative of feedback mechanisms for reporting on the programming process of pacing unit **110** and/or mode selection status indicator for pacing unit **110**. Status indicators **350** may be any type of light emitting mechanism known to those skilled in the art such as LED and/or LCD and/or incandescent lights. Additionally, status indicators **350** may also be used to provide visual signals to communicate pacing information to the athlete during training sessions. In certain preferred embodiments of the present invention, status indicators **350** may incorporate various blinking, strobe, or flashing type lights.

[**0044**] Optional I/O ports **360** provide functionality such as a physical communication capability with computer **130** via communication medium **120** of **FIG. 1** and also may provide the physical connection to recharge the internal battery unit of pacing unit **110**.

[**0045**] Referring now to **FIG. 3A**, a pacing unit **365** in accordance with an alternative preferred embodiment of the present invention is depicted. As shown in **FIG. 3A**, pacing unit **365** comprises a case or housing **395** that is attached to an adjustable wrist or arm band **370** and may house some or all of the following components: a display **390**; one or more programming buttons **380**; and a speaker **385**. Although not visible in **FIG. 3A**, pacing unit **365** may also comprise one or more I/O ports as described in conjunction with **FIG. 3**, thereby allowing for the programming of pacing unit **365** or the reporting of results from pacing unit **365**. Additionally, as previously explained in conjunction with **FIG. 3**, the optional I/O ports provide functionality such as a physical communication capability with computer **130** via communication medium **120** of **FIG. 1** and may also provide a physical connection to recharge the internal battery unit of pacing unit **365**.

[**0046**] The electronic and mechanical components of pacing unit **365** are most preferably impact resistant components that are capable of withstanding the rigors of intense athletic training environments. In some preferred embodiments of the present invention, the various components may also be waterproof. In the most preferred embodiments of the present invention, pacing unit **365** is incorporated into a wristwatch type device for easy accessibility during training sessions. In the most preferred embodiments of the present invention, pacing unit **365** and the various components contained therein are powered by an internal rechargeable battery unit (not shown this FIG.).

[**0047**] Pacing unit **365** may be any type of portable electronic device capable of storing the pace-related information required to implement the methodology of the present invention. The most preferred embodiments of the present invention will incorporate some or all of the same capabilities of computer **130**. As explained in conjunction with the description of computer **130**, pacing unit **365** will typically include some type of processing unit, associated memory and other supporting electronic components. Minimally, pacing unit **365** will be capable of storing and producing the pacing information in a form suitable for use in pace-related training situations.

[**0048**] Display **390** is representative of any typical display commonly employed in portable electronic devices. This includes LCD and LED type displays capable of displaying various types of alphanumeric information. Display **390** may be used to interact with pacing unit **365** during programming and may also provide feedback during pace training sessions. In this preferred embodiment of the present invention, display **390** is capable of displaying overall elapsed time for the present training event or race. Additionally, display **390** is displaying the length of the current segment, the time allotted and/or transpired for the current segment, and the number of the current segment. While illustrative, this specific display is only representative of the type of information that may be displayed and demonstrates only one of many arrangements of the data to be displayed.

[**0049**] Programming buttons **380** are indicative of interface mechanisms that can be used by an athlete to interact with and program the functions of pacing unit **365**. The use of buttons similar to programming buttons **380** for programming small electronic devices such as watches and the like is well known to those skilled in the art. While pacing unit **365** may be programmed via computer software stored in computer **130** of **FIG. 1**, pacing unit **365** may also function in a stand-alone mode and may be programmed and operated completely independent from computer **130**. In the most preferred embodiments of the present invention, each pacing unit **365** will be capable of communicating with computer **130** and exchanging data relevant to pacing training sessions prior to each training session and after completion of each training session. In the case of pacing unit **365**, programming buttons **380** may be used to start and stop timing functions as well as set the number of segments, the length of the segments, and/or the allotted time for each of the segments. Additionally, programming buttons **380** may be used by an athlete to indicate the completion of a given segment or segment, thereby providing a mechanism for monitoring and evaluating performance for a given segment or segments.

[0050] Optional speaker **385** is representative of an optional audio output mechanism that can be used to provide audio programming feedback as well as audible pacing information during training sessions or races. The pacing information may be presented as any audible sound known to those skilled in the art including beeps, a tone or series of tones, MP3 files, .WAV files, etc. Speaker **385** may be a waterproof output mechanism for water-related athletic activities. In addition to receiving feedback via option speaker **385**, the most preferred embodiments of the present invention may also include an optional vibration mechanism (not shown this FIG.), thereby providing tactile feedback to the user of pacing unit **365** as well.

[0051] Optional status indicators **375** are indicative of feedback mechanisms for reporting on the programming process of pacing unit **365** and/or mode selection status indicator for pacing unit **365**. Status indicators **375** may be any type of light emitting mechanism known to those skilled in the art such as LED and/or LCD and/or incandescent lights. Additionally, status indicators **375** may also be used to provide visual signals to communicate pacing information to the athlete during training sessions. In certain preferred embodiments of the present invention, status indicators **375** may incorporate various blinking, strobe, or flashing type lights, thereby providing visual feedback related to pacing for a given segment or segments as well. In some preferred embodiments of the present invention, status indicators **375** may be incorporated into display **390**. In at least one preferred embodiment of the present invention, at least one of status indicators **375** will be a battery level indicator, providing information relative to the amount of battery life left to provide power for pacing unit **365**.

[0052] In the most preferred embodiments of the present invention, pacing unit **110** and pacing unit **365** will each be capable of storing and displaying at least the following information relative to a training or competitive event. First, the total distance to be covered and the total amount of time to complete the total distance. Second, the number of segments to be included in the total distance and the time required to complete each segment. Those skilled in the art will recognize that once the length of the individual segments and the time required to complete the individual segments is understood, then the total distance to be covered and the amount of time to cover the distance can be easily calculated.

[0053] In addition to the embodiments depicted in **FIG. 3** and **FIG. 3A**, other preferred embodiments of pacing units **110** and **365** may be incorporated into caps, hats, swimming goggles, and the like. This allows athletes competing in many different competitive environments to benefit from the advantages of the present invention. Additionally, certain preferred embodiments of the present invention will also comprise a global positioning system (GPS) receiver. When included, the GPS unit will receive a satellite signal that can be used to track an athlete's position over time and provide feedback for training regimen adjustment. By using the GPS unit to note the athlete's position over time, the actual time required to complete a given segment or segments can be calculated and/or determined.

[0054] Referring now to **FIG. 4**, a method **400** in accordance with a preferred embodiment of the present invention is depicted. As shown in **FIG. 4**, a course for training and/or competition is selected (step **410**). It should be noted that the course may be of any distance and may be a course selected for a specific training purpose, i.e., to build endurance, and/or to simulate an actual competition. In any case, the identified course may be a pre-existing course, such as would be described by a certain number of laps around a **400** meter track, or it may be a road course that covers many miles without ever repeating the location of any specific portion of the course.

[0055] After the course has been identified, the course is divided into smaller length segments (step **420**), which may be equal length segments or unequal length segments. Each of the segments is preferably marked by a visual segment indicator (step **430**) so that the individual segments can be identified by the athlete during the course of the event. After the segments have been identified, the desired pace for each segment is determined to correspond to the desired training or performance effect (step **440**). The pace can be determined by selecting the duration of time desired for each segment and dividing the length by the time or, alternatively, the pace can be set by inputting the desired number of steps per second or steps per minute to maintain the desired pace for a given segment. The pace for each segment may be the same as the previous segment or different, as desired and necessary to reach the athlete's optimal performance for a given event. After the desired pace has been selected, the pacing unit **110** assigned to a given athlete can be programmed (step **450**) for that athlete. The actual pace to be maintained by the athlete for each segment can be indicated visually (flashing lights), audibly (tone or beep), or by tactile means with a vibrating mechanism. In any case, the athlete can use the pace indicated by the pacing unit to maintain the desired pace for each segment. While the segment length and pace. for each athlete may be identical, in most applications the segment lengths and pace for various segments for each athlete will most likely be different. It should also be noted that each pacing unit may be programmed directly by entering the course and the course segments, with the corresponding duration or time or desired pace for each segment, into pacing unit **110**. Alternatively, the course segment and pacing information may be programmed into computer **130** and then transferred to each individual pacing unit **110**.

[0056] After completing the event (step **460**), the performance of the athlete for the event can be evaluated (step **470**). This can be accomplished by having the athlete interact with pacing unit **110** during the training event to capture the completion time for each segment by inputting a signal into the pacing unit when the athlete reaches each of the visual segment indicators. Then, as part of a performance improvement plan, each pacing unit **110** can be adjusted to provide for enhanced training and/or performance opportunities in the future. This might include evaluating the pre-programmed training time for each segment with the actual time for each segment on a segment-by-segment basis. An athlete can practice a variable pace over a known distance to simulate race tactics for various situations. As shown in **FIG. 4**, this process can be repeated as necessary to achieve optimal performance. The entire method **400** may be repeated or, in certain training situations, only certain portions may be repeated. For example, it may be desirable to change a given segment or the pace for a given segment and then repeat the same course to see if performance can be enhanced.

[0057] As discussed herein, the present invention allows an athlete to train with a variable pace or paces for a given segment or segments. By adjusting the length of the segment and the duration of time associated with each segment, the desired training effect can be readily achieved. Since previously known pacing units typically function as metronomic devices providing a steady output regardless of the distance or time of training, the pacing unit, with associated segment identifiers and actual time measurements for the segments, an enhanced training regimen can be established and measured. This is especially the case for an athlete that wishes to practice a fluctuating pace strategy for a given race.

[0058] From the foregoing description, it should be appreciated that apparatus and method of the present invention provides significant benefits that would be apparent to one skilled in the art. It is also important to note that although the present invention has been described herein using the sport of running; the various embodiments of the invention are not limited to the sport of rung. Each of the various embodiments of the present invention is equally applicable to other athletic endeavors such as cycling, swimming, speed skating and the like. Furthermore, while multiple embodiments have been presented in the foregoing description, it should be appreciated that a vast number of variations in the embodiments exist. Lastly, it should be appreciated that these embodiments are preferred exemplary embodiments only, and are not intended to limit the scope, applicability, or configuration of the invention in any way. Rather, the foregoing detailed description provides those skilled in the art with a convenient road map for implementing a preferred exemplary embodiment of the invention, it being understood that various changes may be made in the function and arrangement of elements described in the exemplary preferred embodiment without departing from the spirit and scope of the invention as set forth in the appended claims.

1. A pacing unit comprising:

at least one processor;

a memory coupled to said at least one processor;

an event profile residing in said memory, said event profile comprising a plurality of segments, each of said plurality of segments having an associated distance and an associated duration wherein said plurality of segments comprises at least two segments of different distances and two segments of different durations; and

an indicator, said indicator providing a pacing signal to an athlete based on said event profile.

2. The pacing unit of claim 1 further comprising a housing, said housing containing:

a display;

at least one mode selector;

at least one programming button;

a speaker;

a status indicator; and

at least one input/output port.

3. The pacing unit of claim 1 further comprising a computer coupled to said pacing unit, said computer comprising:

at least one processor;

a memory coupled to said at least one processor;

an athlete database residing in said memory, said athlete database containing a plurality of athlete profiles;

an event database residing in said memory, said event database containing a plurality of event profiles; and

a logical connection coupling said pacing unit to said computer.

4. The training apparatus of claim 3 further comprising a master control program residing in said memory, said master control program providing an interface to said athlete database and said event database, said master control program being configurable to program each of said plurality of pacing units.

5. The apparatus of claim 3 wherein said logical connection is a wireless connection.

6. The apparatus of claim 3 wherein said logical connection is a wired connection.

7. The apparatus of claim 3 further comprising a plurality of pacing units coupled to said computer wherein each of said plurality of pacing units comprises:

at least one processor;

a memory coupled to said at least one processor;

an event profile residing in said memory, said event profile comprising a plurality of segments, each of said plurality of segments having an associated distance and an associated duration wherein said plurality of segments comprises at least two segments of different distances and two segments of different durations;

an indicator, said indicator providing a pacing signal to an athlete based on said event profile;

a global positioning system receiver; and

a logical connection coupling said plurality of pacing unit to said computer.

8. The apparatus of claim 7 wherein each of said plurality of pacing units further comprises a display.

9. The apparatus of claim 7 wherein each of said plurality of pacing units further comprises a display, at least one programming button; and a pacing indicator.

10. A training method comprising the steps of:

identifying a training course;

dividing the course into a plurality of segments, each of said plurality of segments having an associated length;

associating a training time with each of said plurality of segments, thereby creating a plurality of training times, each of said plurality of training times having a duration;

programming a pacing unit with data describing each of said plurality of segments and each of said plurality of training times associated with each of said plurality of segments; and

using said pacing unit to train a person on said training course.

11. The method of claim 10 wherein said plurality of segments comprises at least two segments of different lengths.

12. The method of claim 10 wherein said plurality of training times comprises at least two training times of different durations.

13. The method of claim 10 wherein at least one of said plurality of segments comprises a rest segment.

14. The method of claim 10 further comprising the step of marking each of said plurality of segments with one of a plurality of visual segment identifiers.

15. The method of claim 10 wherein said step of using said pacing unit to train an person on said training course comprises the steps of:

inputting a signal into said pacing unit upon reaching each of said plurality of visual segment identifiers thereby creating a plurality of actual segment times with one actual segment time for each of said plurality of segments;

comparing each of said plurality of actual segment times with each of said training times on a segment by segment basis.

16. The method of claim 10 further comprising the step of adjusting said length associated with at least one of said plurality of segments.

17. The method of claim 10 further comprising the step of adjusting, said duration of at least one of said plurality of training times.

18. A training method comprising the steps of:

a) identifying a training course;

b) dividing the course into a plurality of segments, each of said plurality of segments having an associated length, wherein said plurality of segments comprises at least two segments of different lengths and wherein at least one of said plurality of segments comprises a rest segment;

c) marking each of said plurality of segments with one of a plurality of visual segment identifiers;

d) associating a training time with each of said plurality of segments, thereby creating a plurality of training times wherein said plurality of training times comprises at least two training times of different durations;

e) programming a pacing unit with data describing each of said plurality of segments and each of said plurality of training times associated with said plurality of segments;

f) inputting a signal into said pacing unit upon reaching each of said plurality of visual segment identifiers thereby creating a plurality of actual segment times with one actual segment time for each of said plurality of segments;

g) comparing each of said plurality of actual segment times with each of said training times on a segment by segment basis;

h) adjusting said length associated with at least one of said plurality of segments; and

i) adjusting said duration associated with at least one of said plurality of training times.

19. The method of claim 18 wherein said step of comparing each of said plurality of actual segment times with each of said training times on a segment by segment basis comprises the step of using a global positioning system receiver to determine said plurality of actual segment times.

20. The method of claim 18 further comprising the steps of:

repeating steps a-i for a plurality of athletes, thereby creating a plurality of training statistics for said plurality of athletes;

transferring said plurality of training statistics for said plurality of assets to a computer system; and

constructing a customized training regimen for each of said plurality of athletes based on said plurality of training statistics.

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