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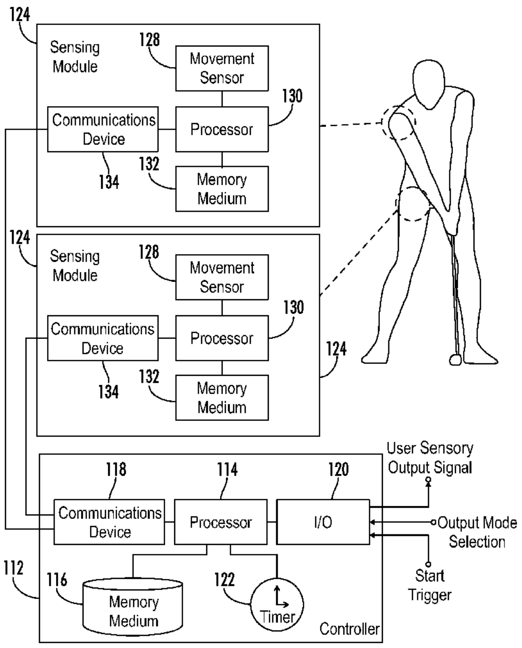

FIG. 1

(57) Abstract: A device and method are provided for training a user to improve their ability to perform complex athletic movements, such as are involved in a golf swing. A plurality of sensing modules are each effective to detect movement of associated body parts of the user and to generate an output signal representative of the detected movement. A controller (112) is linked to each of the sensing modules (124) so as to receive the output signals from the plurality of sensing modules and is further configured to detect movement combinations of the plurality of output signals, compare the detected movement combinations with a predetermined one or more expected movement combinations associated with a complex athletic movement, and generate an output signal such as an audible signal or vibration to the user in substantially real time based on the comparison and a predetermined output mode.

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DESCRIPTION

DEVICE AND METHOD FOR BENEFICIALLY ENGAGING CONSCIOUS BRAIN INFLUENCE DURING COMPLEX ATHLETIC MOVEMENTS

TECHNICAL FIELD

[0001] The present invention relates generally to the neuroanatomy and neurophysiology of complex motor movements. More particularly, the present invention relates to a device that assists (i.e., beneficially engages) the rational, conscious brain of a user in improving the ability of the user to perform certain aspects of an athletic endeavor such as a golf swing.

DISCLOSURE OF THE INVENTION

[0002] As an illustrative example within the scope of the present invention, the rational, conscious brain of a person decides to learn a new activity which involves the learning by that person of complex motor movements. In this example, the activity selected is the sport of golf, which involves a sequence of seemingly simple movements that are in practice quite complex and can be (as virtually any golfer will attest) exceedingly frustrating to master. A golf club is selected, a ball is placed on the ground and the pre-motor and motor cortexes become very involved in attempting and (finally, after many, many balls have been struck) mastering the swing to a level where it is very repeatable. At this point the motor movements involved are transferred to the subconscious cerebellum for execution each time a golf swing is performed. The swing is repeatable but may not be very effective for hitting the ball straight, or as far or as high as desired, etc.

[0003] This is especially true if an activity such as golf is first learned as an adult. The swing is typically executed from start to finish (striking of the ball) in less than one and a half seconds, which is far too fast for any sensory feedback. What the rational, conscious brain would like to do is get the pre-motor and motor cortexes involved again to change the swing and get the desired results, but it cannot because it does not know exactly what it wants changed, and neither do the pre-motor and motor cortexes. In other words, for a person to say that they want to stop "slicing" the ball is to desire a change in the result of the swing itself as subconsciously imprinted, not some part of the swing that is rationally and consciously adjusted through post-facto feedback.

[0004] Briefly stated, in an exemplary embodiment of the present invention a device and method are provided for substantially real-time cognitive training of a user to improve their ability to perform complex athletic movements, such as may for example be involved in a golf swing, football pass, baseball throw, and the like. A plurality of sensing modules are each effective to detect movement of associated body parts of the user and to generate an output signal representative of the detected movement. A controller is linked to each of the sensing modules so as to receive the output signals from the plurality of sensing modules and is further configured to detect movement combinations of the plurality of output signals, compare the detected movement combinations with a predetermined one or more expected movement combinations associated with a complex athletic movement, and generate an output signal such as an audible signal or a buzz to the user in substantially real time based on the comparison and a predetermined output mode.

[0005] Another aspect of the embodiment previously described is that the controller may be configured to compare a sequence of detected movement combinations with a predetermined sequence of expected movement combinations, to generate a first output logic state for each detected movement combination in the sequence that satisfies an associated expected movement combination, and to generate a second output logic state for each detected movement combination in the sequence that fails to satisfy an associated expected movement combination.

[0006] In another aspect, the predetermined output mode may include commands to generate an output signal for either of the first or second output logic state in association with any one or more of the expected movement combinations.

[0007] In another aspect, a timer may be included with the system, whereby the controller may generate first or second output logic states for a detected movement combination based on the expected movement combination and an expected time period for performing the expected movement combination.

[0008] In another aspect, the first and second sensing modules may each include one or more of an accelerometer, a gyro-sensor and a wireless transmitter which is functionally linked to the controller.

[0009] In another aspect, for a right-handed user the first sensing module may be configured for positioning on or around the waist of the user and the second sensing module may be configured for positioning on the right shoulder of the user, further wherein the predetermined one or more expected movement combinations associated with the golf swing further may be defined as (1) a first movement combination of a left-to-right movement of both the first and second sensing modules; (2) a second movement combination of a clockwise rotation of both of the first and second sensing modules; (3) a third movement combination of a counter-clockwise rotation of the first sensing module in association with a continued clockwise rotation of the second sensing module; and (4) a fourth movement combination of a counter-clockwise rotation of both the first and second sensing modules. The movement combinations may be correspondingly reversed where the user is left-handed.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010] Fig. 1 is a block diagram representing an embodiment of a system in accordance with the present invention.

[0011] Fig. 2 is a flowchart representing an exemplary method for a controller of the system of Fig. 1.

[0012] Fig. 3 is a flowchart representing an exemplary sub-process within the scope of the method of Fig. 2.

[0013] Figs. 4(a) to 4(f) are a sequence of front views representing an exemplary sequence of detected movement combinations for a user of the system of Fig. 1 in various stages of a golf swing.

[0014] Fig. 5 is a flowchart representing another exemplary method for a controller of the system of Fig. 1.

BEST MODE FOR CARRYING OUT THE INVENTION

[0015] Throughout the specification and claims, the following terms take at least the meanings explicitly associated herein, unless the context dictates otherwise. The meanings identified below do not necessarily limit the terms, but merely provide illustrative examples for the terms. The meaning of “a,” “an,” and “the” may include plural references, and the meaning of “in” may include “in” and “on.” The phrase “in one embodiment,” as used herein does not necessarily refer to the same embodiment, although it may.

[0016] The present disclosure relates in various aspects to the principles of training the cerebellum to perform complex motor skills automatically and without conscious interference by the cerebral cortex, exemplary support for which may be found in various passages from “The Brain: A Neuroscience Primer” by Richard F.

Thompson and "Medical Neuroscience" by Thomas C. Pritchard and Kevin Douglas Alloway, herein incorporated by reference in their entirety. The complex motor skills as described herein may for the purposes of simplicity in explanation relate to components of a golf swing, but unless otherwise stated the principles may equally without limitation to various alternative athletic movements including for example the swinging of a baseball bat or throwing a ball (a football pass, a baseball pitch, a basketball free throw, etc.).

[0017] Briefly stated, experiments indicate that the motor areas in the cerebral cortex (e.g., the primary motor cortex and pre-motor cortex) play a key role in the learning of complex motor skills, but that the permanent memory for well-learned complex motor skills appears to be stored in the cerebellum. These results agree with common experiences in learning a complex motor skill such as for example a golf swing. Initially, we concentrate awareness on every aspect of the movement, massively involving the cerebral cortex. As learning proceeds, the golf swing becomes more and more automatic- we become much less aware of the movement components. Finally, when the swing is very well-learned, its execution is best performed without awareness (i.e., via the cerebellum).

[0018] Indeed, if we try to think about the movements as the swing occurs, this interferes with the swing itself. For example, the golfer that determines his hands need to be in a certain position at the top of the backswing may concentrate on moving his hands to the detriment of other aspects of the swing. It is as though the cerebral cortex now interferes with cerebellar involvement in execution of the movements.

[0019] A series of studies which may be particularly relevant here, as conducted in Japan by Okihide Hikosaka and associates, monkeys were trained over an extended period of time to perform simple tasks, some of which were well learned at the end of the extended period and others of which were just being learned. A critical region of the pre-motor cortex for the monkeys was temporarily rendered inactive by administering a small amount of the drug muscimol. During this experiment tasks which were still being learned by the monkeys were markedly impaired in performance, but there was no such effect on the performance of well-learned tasks. The inverse was true when the experiment was conducted by inactivating a critical region of the cerebellum (the interpositus cerebellar nucleus), at which time the performance of well-learned tasks was markedly impaired but there was no such effect on tasks which were still being learned at the time.

[0020] One takeaway cited from these experiments is that while the pre-motor cortex is heavily involved in the preliminary stages of actually learning complex motor movements, such as for example a golf swing or equivalent athletic sequence of movements, the cerebellum is where the relevant memory traces are stored when the complex motor movements become well-learned. Therefore, whereas learning a complex motor movement such as for example a golf swing requires a degree of focus and concentration of the pre-motor cortex, ideally a well-learned golf swing would be substantially an automatic movement orchestrated by the cerebellum, with conscious (i.e., originating in the cerebral cortex) manipulation of the swing being generally counterproductive. After adopting a new golf swing, it is necessary to practice until the cerebellum assumes control of the associated movements and executes them automatically.

[0021] Another important principle with regards to the present invention is that post facto feedback correction of errors with respect to complex motor movements does not effectively cause the cerebellum to assume control of the movements. In contrast to feedback control theory, in which a controller relies on feedback of a controlled variable and responds to adjust for measured results, a feed-forward control proactively addresses conditions that may be anticipated rather than relying on delayed feedback and provides guidance based on learned behavior. In a predictive feed-forward-type mode, the cerebellum therefore may effectively guide movements that take place far too quickly to benefit from post facto feedback (i.e., a golf swing). For example, the process of swinging a golf club takes place in a time period too brief to benefit from sensory feedback. Proper execution of such rapid movements therefore depends primarily on past experience and the associated predictive effects of imprinted and habitual motor sequences.

[0022] Referring generally to Figs. 1- 5, various embodiments of systems, devices and methods may be described herein for assisting (i.e., beneficially engaging) the rational, conscious brain of a user in improving the ability of the user to perform certain aspects of an athletic endeavor such as a golf swing. To get the pre-motor and motor cortex involved again in changing the swing, or motor movement, the conscious brain must have a very specific movement change to be accomplished and the conscious brain must further know in substantially real-time if the change has been made for each individual swing or motor movement. Where the various figures may describe embodiments sharing various common elements and features with other embodiments, similar elements and features are given the same reference numerals and redundant description thereof may be omitted below.

[0023] An exemplary embodiment of a system 100 as represented in Fig. 1 may generally include a controller device 112 having a processor 114, one or more memory media 116, a communications device 118 for sending and receiving signals to and from associated movement sensing modules 124, an I/O module 120 and a timer 122.

[0024] The communications device 118 may in various embodiments be a dedicated device effective to communicate directly with the sensing modules 124 via a communications network 136, while the I/O module 120 may be effective to send and receive associated signals via a separate network or via user selectable switches or the like physically located on a housing associated with the controller 112. Alternatively, the communications device 118 and I/O module 120 may both communicate across the same network and intermediary devices, such as for example where a single user computing device may include a mobile application effective to collect, combine, coordinate and transmit sensed movement signals and also I/O signals to the controller, and the communications device 118 and I/O module 120 may further be integral in structural design if not with respect to their respective functional aspects.

[0025] The term “signal” as used herein may include any meanings as may be understood by those of ordinary skill in the art, including at least an electric or magnetic representation of current, voltage, charge, temperature, data or a state of one or more memory locations as expressed on one or more transmission mediums, and generally capable of being transmitted, received, stored, compared, combined or otherwise manipulated in any equivalent manner.

[0026] Terms such as “providing,” “processing,” “supplying,” “determining,” “calculating” or the like may refer at least to an action of a computer system, computer program, signal processor, logic or alternative analog or digital electronic device that may be transformative of signals represented as physical quantities, whether automatically or manually initiated.

[0027] The term “controller” as used herein may refer to at least a general microprocessor, an application specific integrated circuit (ASIC), a digital signal processor (DSP), a microcontroller, a field programmable gate array, or various alternative blocks of discrete circuitry as known in the art, designed to perform functions as further defined herein.

[0028] "Memory media" may further include without limitation transmission media and/or storage media. "Storage media" may refer in an equivalent manner to volatile and non-volatile, removable and non-removable media, including at least dynamic memory, application specific integrated circuits (ASIC), chip memory devices, optical or magnetic disk memory devices, flash memory devices, or any other medium which may be used to stored data in a processor-accessible manner, and may unless otherwise stated either reside on a single computing platform or be distributed across a plurality of such platforms. "Transmission media" may include any tangible media effective to permit processor-executable software, instructions or program modules residing on the media to be read and executed by a processor, including without limitation wire, cable, fiber-optic and wireless media such as is known in the art.

[0029] The term "processor" as used herein may refer to at least general-purpose or specific-purpose processing devices and/or logic as may be understood by one of skill in the art, including but not limited to single- or multithreading processors, central processors, parent processors, graphical processors, media processors, and the like.

[0030] The term "communications network" as used herein with respect to data communication between two or more parties or otherwise between communications network interfaces associated with two or more parties may refer to any one of, or a combination of any two or more of, telecommunications networks (whether wired, wireless, cellular or the like), a global network such as the Internet, local networks, network links, Internet Service Providers (ISP's), and intermediate communication interfaces.

[0031] The sensing modules 124 as represented include a movement sensor 128, a processor 130, a memory medium 132 and a communications device 134. However, in various embodiments certain of the components represented may be redundant, where for example signals from the movement sensor may be transmitted directly to the controller 112 without any collecting, temporary storing, filtering, etc., as may otherwise be performed locally using the additional components in manners well known to those of skill in the art.

[0032] The sensing modules 124 may further be configured to be positioned on predetermined locations associated with a user 126 so as to communicate movements of the person as determined by sensed positions of the modules with respect to each other. In Fig. 1, first and second sensing modules 124a, 124b are indicated as being positioned on the right hip and right shoulder of the user 126, respectively, and such description will generally be used consistently in this disclosure, but is in no way intended as limiting on the scope of the present invention and various alternative embodiments are anticipated with regards to the number of sensing modules 124, associated positions on a user's body, and combinations thereof.

[0033] The sensing modules 124 in an exemplary embodiment may individually be formed by for example acceleration sensors as are known in the art for detecting linear acceleration in a plurality of directions (along a plurality of axes in accordance with the configuration of the accelerometer) and output signals from which in combination with an appropriate signal processing unit may be used to determine tilt, rotation or position of the corresponding sensor. Dual- and (more preferably) triple-axis linear accelerometers as previously known in the art and which may be used by the system of the present invention include those for example manufactured by Analog Devices, Inc. or by STMicroelectronics, N.V. In other exemplary embodiments, the sensing modules 124 may be formed by a gyro-sensor or equivalent sensing technology utilizing rotating or vibrating elements, further examples of which are available from Analog Devices, Inc. The processes necessary to detect tilt, movement or position of the individual sensing modules, and further to detect position or movement combinations of a user having such modules located on their person, vary depending on the type of sensor used. Additional detail regarding linear acceleration sensors and gyro-sensors as embodied within a position detection controller is disclosed in U.S. Patent No. 7,834,848 as assigned to Nintendo Co., Ltd., and relevant portions of which are hereby incorporated by reference, but without being limiting thereby with regards to the scope of the present invention.

[0034] Referring now to Fig. 2, a method 200 may be described in accordance with various embodiments of the present invention. The method may begin (step 202) by identifying one or more predetermined expected movement sequences. For the purposes of this description, the movement sequences may be related to a golf swing, and more particularly to a desired sequence of movements as represented in Fig. 4

and further described below. Some exemplary support for this selection of movement sequences may be provided by Dr. Ralph Mann and Fred Griffin in "Swing Like a Pro," the entirety of which is incorporated by reference herein, but it may be understood that a substantially different sequence of movements may likely be predetermined in accordance with the present invention relating to a different athletic movement, and even with respect to a golf swing in accordance with golf instructors of varying teaching perspectives. In various embodiments a number of expected movement sequences may for example be programmed in a memory medium and selectable depending on the type of athletic movement, or a plurality of memory media may individually be programmable with a given sequence. Whether selected by a user from a plurality of available sequences, or where a single sequence is available, the system may generally be able to therefore identify a sequence to which actual movements may be compared.

[0035] The method 200 further involves (step 204) identifying a predetermined output mode. As with step 202 as described above, the output mode may in various embodiments be programmed and non-selectable, or may be user-selectable from a plurality of mode options. Generally speaking, the output mode may determine the format in which sensory output signals are to be provided by the system in response to measured movement combinations and in relation to the predetermined sequence of movement combinations. For example, a user may elect to receive sensory output signals for any one or more movement combinations from a list of movement combinations, and may elect to have the output signals provided when the movement combinations are carried out either correctly or incorrectly. In an embodiment, the user may select an output mode in which the system measures a first movement combination in a golf swing, and generates a first logic state (e.g., a zero (0)) when the movement combination is performed correctly (or adequately), and a second logic state (e.g., a one (1)) when the movement combination is performed incorrectly, wherein the system generates a sensory feedback signal (audio, vibration, etc.) for either of the first or second logic state) as further set as part of the output mode. The logic one and logic zero may further be embodied by or otherwise correspond to output states for any number of I/O structures, such as for example open and closed relay positions, respectively, or duty cycle adjustment for a pulse width modulated output signal.

[0036] It may be desirable to have the system provide sensory output signals for any movement combination in the entire sequence that is performed incorrectly, or alternatively it may be desirable to have the system only respond when all of the movement combinations are performed correctly, and as may be understood by one of skill in the art the possibilities for the output modes may vary dramatically in accordance with the user needs and the type of athletic movements contemplated.

[0037] It may in an embodiment be further desirable to have the system provide varying types or degrees of sensory output signals for any individual movement which is outside of a predetermined tolerance for an expected correlating movement. In such a case, where for example a first and second sensor combination is used (S1, S2, respectively), instead of providing a particular output for S1 AND S2 being correct in view of a predetermined movement combination or S1 NOR S2 being correct in view of the predetermined movement combination, the system may for example provide a first output type or degree for S1 AND S2, a second output type or degree for S1 OR S2, and a third output type or degree for S1 NOR S2.

[0038] The system further (in step 206) identifies a start position for the user. This may in various embodiments include determining that the user is in a predetermined starting position (such as for example standing on or proximate a stationary sensor), or receiving a manually provided input signal as a start trigger, or even determining that the user has been in a predetermined starting position (e.g., determined relative to the movement sensors) for a period of time greater than a threshold time period. In a particular embodiment, the system may receive an input signal in the form of a verbal command that initiates detection of movement combinations in accordance with the identified predetermined movement combinations (i.e., enters a startup mode). The actual form of the start trigger may not be intended as limiting on the scope of the present invention, however.

[0039] Once the system has entered startup mode, the controller begins (in step 208) receiving input signals from the movement sensing modules and any other sensing modules which may be used in various embodiments, such as for example sensors to detect weight shifts, head movement, feet spacing, etc, and then (in step 210) begins detecting movement combinations based on the processed input signals. In some embodiments the input signals from the sensing modules may be “raw” data which is processed in the controller to determine positions of the sensors, for example where the movement combinations are relative to a remote point such as a stationary sensor. Alternatively, the positions may be at least partially processed internally to the respective sensing modules such that the input signals themselves are representative of movement with respect to respective axes.

[0040] For exemplary purposes only this description may refer to input signals from the sensing modules representative of a movement along either of an x- or y-axis (i.e., left-to-right for a right-handed golfer and right-to-left for a left-handed golfer) and of rotation about a z-axis (i.e., about an axis roughly correlating to the torso of the golfer from head-to-foot), wherein the controller is configured to determine whether predetermined tolerances for each movement combination are met and therefore the movement combination confirmed (step 212). If for example a first movement combination requires that both of first and second sensing modules detect a movement along one axis (i.e., from left-to-right for a right-handed golfer) as in Fig. 4(b), the controller may receive input signals representing movement in the appropriate direction and of a certain magnitude, and compare the magnitude and direction to parameters (i.e., tolerances for magnitude and direction) associated with an expected first movement combination in order to determine that the first movement combination has been performed properly.

[0041] In various embodiments a timer may be used during this step as well, such as for example where one or more of the expected movement combinations include a time period during or by which the movement combination is to be performed. This is primarily the case for a “launch” movement combination, as will be further described below in relation to an embodiment where the conscious brain is to be focused on the launching aspect and disengaged from other aspects of the athletic movement generally, but may apply in other movement combinations as well where desired by the user or system operator.

[0042] Where the expected movement combination has been determined to be performed correctly (or incorrectly) the system may then generate a sensory output signal to the user if the identified output mode so requires (step 214). For example, if the user has selected an output mode that provides sensory output (audio, vibration, etc.) only if the first movement combination is done incorrectly, the system would do nothing if the movement combination has been determined as performed correctly, but instead generate an output signal in substantially real-time to an external device capable of providing the desired sensory effect if the movement combination was performed incorrectly. If the user instead selected an output mode that provides sensory output only where all of the movement combinations are performed correctly in the predetermined sequence, then the system would do nothing in either case unless the movement combination just performed was the last in the sequence (e.g., where the first movement combination has been determined as performed correctly, or the movement combination was performed incorrectly).

[0043] Referring now to Figs. 3 and 4, a more particular exemplary method 300 of the present invention is presented with respect to a golf swing. Various aspects of the golf swing are not explicitly described herein (e.g., the grip, setup, etc.) as the effect of the conscious brain is relatively less disruptive than during the swing itself, but it may be understood that additional sensors may be provided for measuring movement or position in these other areas by a device or system within the scope of the present invention. While four movement combinations are herein described as a predetermined sequence of movement combinations, more or fewer combinations may foreseeably be used, and furthermore it may be understood that the movement combinations described herein may not be universal in application with regards to the golf swing itself and may be differently configured within the scope of the present invention. While a logic one and logic zero in the method 300 represented in Fig. 3 refer to incorrect and correct detected movement combinations with respect to expected movement combinations, respectively, the opposite may in various embodiments be the case. Also, the predetermined movement combinations represented in Fig. 3 are described with respect to a right-handed golfer, and may be merely inverted in direction with respect to a left-handed golfer.

[0044] Beginning with step 302, the golf swing includes a first predetermined movement combination from a starting position (402 in Fig. 4(a)) wherein a first sensing module (S1, located for example on the right hip of the golfer) is expected to move back, or in other words from left-to-right, and a second sensing module (S2, located for example on the right shoulder of the golfer), is also expected to move back. See for example movement combination 404 in Fig. 4(b). In this way the system may confirm that at least the measured portions of the body of the golfer are properly shifting laterally at the same time and, at least theoretically unless sensors are also placed on the feet, confirming that weight is shifting from the front (left) foot to the back (right) foot. The tolerances set for determining that the movement is taking place may generally be relatively small, as only a few inches from left-to-right may be sufficient in various embodiments to satisfy the first step.

[0045] If the expected movement combination for the two sensing modules (S1= Back and S2= Back) is not detected (i.e., "NO" in response to the query in step 302) the controller in step 304a generates a logic zero output state (OUT=0). If the expected movement combination for the two sensing modules is detected, however, (i.e., "YES" in response to the query in step 302) the controller in step 304b generates a logic one output state (OUT=1) and then continues with the process. Whether or not the output state results in a sensory output signal may generally depend on the predetermined output mode as previously described with respect to Fig. 2.

[0046] A second predetermined movement combination (step 306) includes the first sensing module S1 rotating clockwise with respect to if not necessarily directly about a vertical axis roughly corresponding to the torso of the golfer, and more particularly with the right leg of the golfer although it may be understood that systems in accordance with the present invention may adequately function without being so precise, and the second sensing module S2 is also expected to rotate clockwise. See for example movement combination 406 in Fig. 4(c). In some embodiments the second predetermined movement combination may further require that no additional lateral movement (i.e., from front-to-back) is detected during this phase, as continued shifting of the body may dramatically impede recovery during the downswing.

[0047] If the expected movement combination for the two sensing modules (S1= CW and S2= CW) is not detected (i.e., "NO" in response to the query in step 306) the controller in step 308a generates a logic zero output state (OUT=0). If the expected movement combination for the two sensing modules is detected, however, (i.e., "YES" in response to the query in step 306) the controller in step 308b generates a logic one output state (OUT=1) and then continues with the process. Whether or not the output state results in a sensory output signal may generally depend on the predetermined output mode as previously described with respect to Fig. 2.

[0048] A third predetermined movement combination (step 310) includes the first sensing module S1 continuing to rotate clockwise as with the previous movement combination, but the second sensing module S2 is expected to reverse direction and to rotate counter-clockwise. See for example movement combination 408 in Fig. 4(d). In certain embodiments where sensors are further located on the feet of the golfer, the third movement combination may require that both feet be on the ground during this phase and may further or alternatively require a weight shift from the right (back) heel to the left (front) foot. The third expected movement combination may further or alternatively require for example that both sensing modules detect a reversal in lateral movement during the third phase to the opposite direction from the first phase (i.e., back-to-front). This third phase may generally provide a stable base of support in the lower body of the golfer for the unwinding of the upper body of the golfer to take place in the fourth phase.

[0049] If the expected movement combination for the two sensing modules (S1= CCW and S2= CW) is not detected (i.e., "NO" in response to the query in step 310) the controller in step 312a generates a logic zero output state (OUT=0). If the expected movement combination for the two sensing modules is detected, however, (i.e., "YES" in response to the query in step 310) the controller in step 312b generates a logic one output state (OUT=1) and then continues with the process. Whether or not the output state results in a sensory output signal may generally depend on the predetermined output mode as previously described with respect to Fig. 2.

[0050] The fourth predetermined movement combination (step 314) includes the first sensing module S1 reversing in direction and now rotating counter-clockwise to join the expected rotational movement of the second sensing module S2. See for example movement combination 410 in Fig. 4(e). If the expected movement combination for the two sensing modules (S1= CCW and S2= CCW) is not detected (i.e., "NO" in response to the query in step 314) the controller in step 316a generates a logic zero output state (OUT=0). If the expected movement combination for the two sensing modules is detected, however, (i.e., "YES" in response to the query in step 314) the controller in step 316b generates a logic one output state (OUT=1) and then continues with the process. Whether or not the output state results in a sensory output signal may generally depend on the predetermined output mode as previously described with respect to Fig. 2.

[0051] Various embodiments of a system in accordance with the present invention so described may be configured differently depending on the desired effect. For example, an embodiment of the present invention that included steps 302 to 316 as described above may effectively be used to beneficially engage the conscious brain and improve the golf swing through repetition and training by providing sensory feedback in substantially real-time rather than relying on post-facto feedback and error correction. In another embodiment, additional steps as described below may be effective to disengage the conscious brain during the downswing so as to reduce or prevent conscious attempts to influence aspects of the swing as would otherwise be originating from the cerebellum. While a system or device of the present invention may be capable of performing in accordance with both embodiments, it may generally be desirable to only perform those steps associated with one embodiment at a given time. Alternatively, the system may be configured such that only one of the embodiments may be selected and thereby effective at a given time.

[0052] Upon detecting of the fourth movement combination (S1= CCW and S2= CCW), the controller may start a timer or otherwise stated begin tolling a predetermined time period associated with the fourth movement combination (step 318). Upon lapsing of the time period (i.e., "YES" in response to the query of step 320) the controller generates a logic one output state (OUT=1). In certain embodiments this may actually be a logic zero output state depending on the output mode, but generally the controller is configured to generate a sensory output signal from the I/O upon lapsing of the time period. Briefly stated, after sufficient repetition the conscious brain becomes attuned to the sensory output at the predetermined time period corresponding to the fourth predetermined movement combination (the downswing) and focuses on this time period to the exclusion of the other (and more disadvantageous) aspects of the swing that the conscious brain would otherwise be wont to influence.

[0053] In an alternative embodiment, the controller may be further configured to detect completion of the fourth movement combination, determine an actual time of completion for the fourth movement combination, compare the actual time of completion to the predetermined time period, and generate a sensory output signal depending on the comparison and a predetermined sensory output mode. For example, a sensory output may be provided when the actual time of completion is less than or greater than the predetermined time period, or outside of a time period range about the predetermined time period.

[0054] Referring now to Fig. 5, a method 500 in accordance with the present invention may apply more generally to a range of complex athletic movements including not only to a golf swing but further to a baseball swing, baseball pitch, football pass, hockey slap shot, soccer kick, etc., so as to beneficially engage the conscious brain. The method 500 still detects movement combinations with respect to sensing modules, and sequentially compares the detected movement combinations with expected movement combinations, but the phases may be defined more broadly. In various embodiments, a number of athletic movements may be programmed into a common controller and selectable by the user as desired.

[0055] For exemplary purposes, the method 500 may be described herein with respect to both of a baseball pitch and the golf swing as described in greater detail above.

[0056] In step 502, the controller detects a "takeaway" (or windup) movement by the user. As with the first and second phases of the golf swing (see Figs. 4(b) and 4(c)) the takeaway in principle may similarly apply to the baseball pitch as the pitcher laterally shifts weight away from the target (the batter) and rotates the shoulders in a clockwise manner.

[0057] The controller then in step 504 detects a "transition" movement which corresponds with the third phase of the golf swing (see Fig. 4(d)). The pitcher here begins to rotate the trunk of the body toward the batter while the right arm remains back or even continues rotating clockwise. For a moment the baseball may even be completely stationary with respect to the ground even though the remainder of the pitcher's body is rotating sharply toward the batter.

[0058] The controller then in step 506 detects a "launch" movement (not to be confused with release) which corresponds with the fourth phase of the golf swing (the downswing, see Fig. 4(e)) and may (where applicable) start the timer in step 508. The pitcher here begins rotating the shoulder of the right (pitching) arm counter-clockwise and toward the batter generally.

[0059] In an optional step, the system may include sensors effective to detect contact with or release of a ball that is the object of the athletic movement (step 510). The controller may accordingly be configured to determine an actual time of completion for the "launch" step from transition to contact/release, compare the actual time of completion to the predetermined time period, and generate a sensory output signal depending on the comparison and a predetermined sensory output mode. For example, a sensory output may be provided when the actual time of completion is less than or greater than the predetermined time period, or outside of a time period range about the predetermined time period.

[0060] In certain embodiments the controller may be provided with an automatic sensory output mode (i.e., "YES" in response to the query in step 512), in which case the controller generates a sensory output signal upon lapsing of a predetermined time period from the tolling of the timer.

[0061] In embodiments where the controller is not provided with an automatic sensory output mode (i.e., "NO" in response to the query in step 512), whether or not the sensory output signal is provided by the controller may depend on an output state associated with the performance of the expected movement combinations (step 516). For each movement combination associated with the predetermined output state (which may for example be any one or more of the available movement combinations or alternatively the entire sequence upon completion) the controller may generate (in step 518) a first output state where the detected movement combinations are not in accordance with the expected movement combinations and any associated tolerances or other parameters (i.e., "NO" in response to the query in step 516). Likewise, the controller may generate (in step 520) a second output state where the detected movement combinations are in accordance with the expected movement combinations and any associated tolerances or other parameters (i.e., "YES" in response to the query in step 516).

[0062] The previous detailed description has been provided for the purposes of illustration and description. Thus, although there have been described particular embodiments of the present invention of a new and useful "Device and Method for Beneficially Engaging Conscious Brain Influence During Complex Athletic Movements," it is not intended that such references be construed as limitations upon the scope of this invention except as set forth in the following claims.

CLAIMS

What is claimed is:

1. A system for substantially real-time cognitive training of a user with respect to the performance of complex athletic movements, the system comprising:

a plurality of sensing modules, each sensing module comprising one or more movement sensors and effective to detect movement of an associated body part of the user; and

a controller device communicatively linked to each of the sensing modules and effective to

detect movement combinations based on each of said detected movements with respect to each other;

sequentially compare the detected movement combinations with a predetermined sequence of one or more expected movement combinations associated with a complex athletic movement combination, and

generate one or more sensory output signals to the user in substantially real time based on the comparison results and a predetermined output mode, said sensory output signals comprising audio or vibration output signals provided to the user and corresponding to the respective expected movement combinations.

2. The system of claim 1, the controller effective to generate a first output logic state for each detected movement combination in the sequence that satisfies an associated expected movement combination, and to generate a second output logic state for each detected movement combination in the sequence that fails to satisfy an associated expected movement combination.

3. The system of claim 2, the predetermined output mode comprising commands to generate sensory output signals for either of the first or second output logic state in association with any one or more of the expected movement combinations.

4. The system of claim 3, further comprising a timer, the controller effective to generate first or second output logic states for a detected movement combination based on the expected movement combination and an expected time period for performing the expected movement combination.

5. The system of claim 4, the controller effective to detect movement combinations associated with the plurality of sensing modules beginning from a starting position

established by the controller after a predetermined period of time lapsing with less than a threshold level of movement.

6. The system of claim 4, the controller effective to identify the predetermined movement combination of the plurality of sensing modules after an external start signal is received by the controller.

7. The system of claim 1, the sensing modules comprising a linear accelerometer and a wireless transmitting device.

8. The system of claim 1, the sensing modules comprising a gyro-meter and a wireless transmitting device.

9. A system for training a user to improve their ability to perform a golf swing, the system comprising:

a first sensing module comprising a first movement sensor and configured for positioning in association with a first body part of the user, and effective to detect movement of said first body part and to generate a signal representative of the detected movement;

a second sensing module comprising a second movement sensor configured for positioning in association with a second body part of the user, and effective to detect movement of said second body part and to generate a signal representative of the detected movement; and

a controller device communicatively linked to the first and second sensing modules and effective to

receive input signals from the first and second sensing modules,

detect movement combinations of the plurality of input signals,

sequentially compare the detected movement combinations with a predetermined sequence of one or more expected movement combinations associated with the golf swing, and

generate a sensory output signal to the user in substantially real time based on the comparison and a predetermined output mode, said sensory output signal comprising an audio or a vibration output signal provided to the user and corresponding to the respective expected movement combination.

10. The system of claim 9, the controller effective to generate a first output logic state for each detected movement combination in the sequence that satisfies an associated expected movement combination, and to generate a second output logic

state for each detected movement combination in the sequence that fails to satisfy an associated expected movement combination.

11. The system of claim 10, the predetermined output mode comprising commands to generate a sensory output signal for either of the first or second output logic state in association with any one or more of the expected movement combinations.

12. The system of claim 11, further comprising a timer, the controller effective to generate first or second output logic states for a detected movement combination based on the expected movement combination and an expected time period for performing the expected movement combination.

13. The system of claim 12, the first and second sensing modules each comprising one or more of an accelerometer, a gyro-sensor and a wireless transmitter functionally linked to the controller.

14. The system of claim 13, wherein for a right-handed user the first sensing module is configured for positioning on or around the waist of the user and the second sensing module is configured for positioning on the right shoulder of the user, the predetermined one or more expected movement combinations associated with the golf swing further comprising

a first movement combination of a left-to-right movement of both the first and second sensing modules,

a second movement combination of a clockwise rotation of both of the first and second sensing modules,

a third movement combination of a counter-clockwise rotation of the first sensing module in association with a continued clockwise rotation of the second sensing module, and

a fourth movement combination of a counter-clockwise rotation of both the first and second sensing modules.

15. A device for substantially real-time cognitive training of a user with respect to the performance of complex athletic movements, said device comprising a processor and one or more non-transitory processor-readable memory media having program instructions residing thereon, said program instructions executable by the processor to direct the performance of:

receiving a plurality of input signals via a communications network from a respective plurality of movement sensors, the input signals representative of actual movements within a complex athletic movement by a respective body part of a user;

identifying a predetermined sequence of_one or more expected movement combinations associated with said complex athletic movement;

detecting actual movement combinations associated with respective groups of input signals;

sequentially comparing each actual movement combination with a corresponding expected movement combination, and

based on the comparison and a predetermined output mode, generating a sensory output signal comprising an audio or a vibration output signal to the user in concert with said complex athletic movement.

16. The device of claim 15, the program instructions executable to direct the performance of:

generating a first output logic state for each actual movement combination in the sequence that satisfies an associated expected movement combination; and

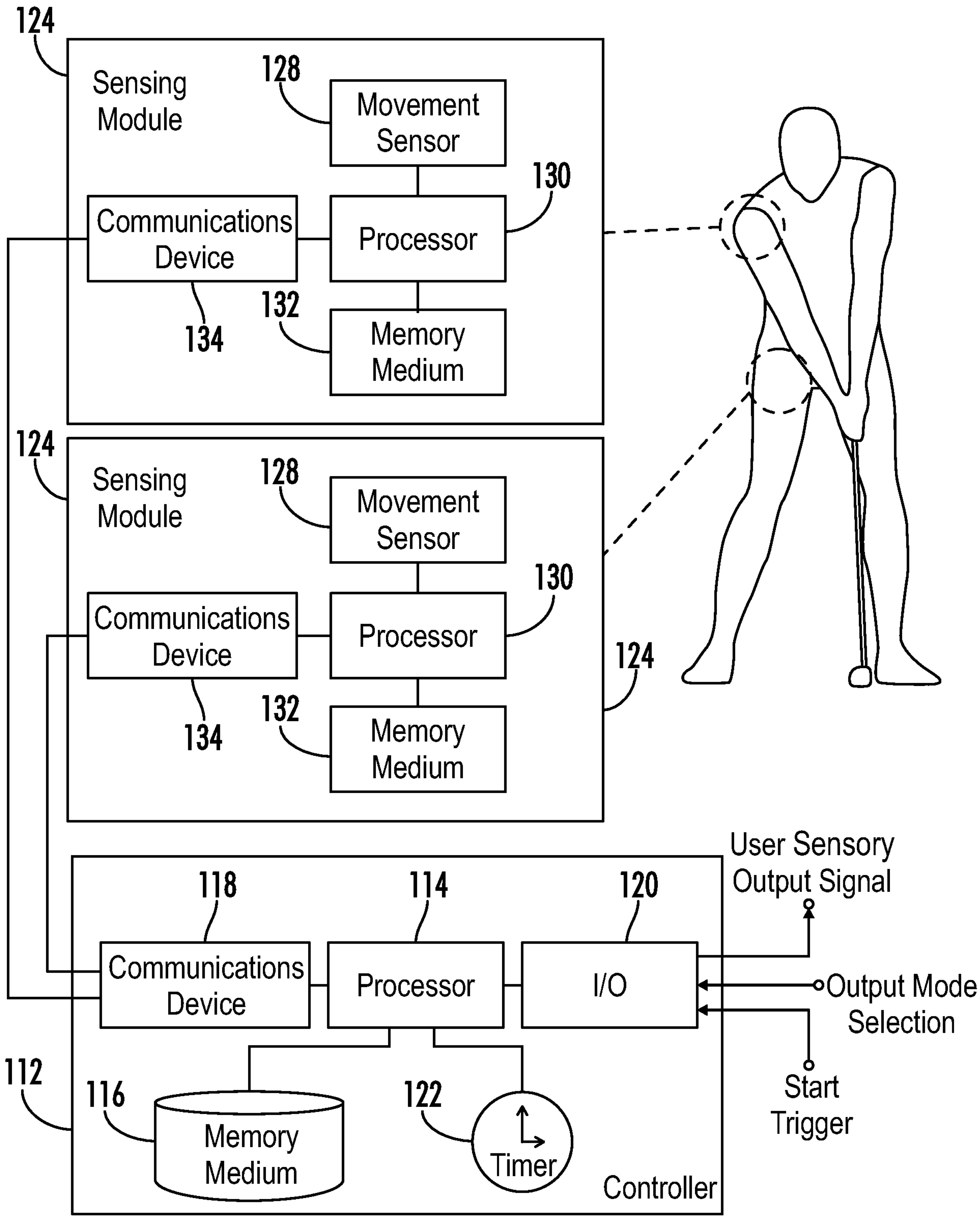
generating a second output logic state for each actual movement combination in the sequence that fails to satisfy an associated expected movement combination.

17. The device of claim 16, the predetermined output mode comprising commands to generate a sensory output signal for either of the first or second output logic state in association with any one or more of the expected movement combinations.

18. The device of claim 17, the program instructions further executable to direct the performance of generating said first or second output logic states for a detected movement combination based on the expected movement combination and an expected time period for performing the expected movement combination.

19. The device of claim 18, the program instructions further executable to direct the performance of detecting movement combinations represented by the one or more input signals beginning from a starting position established after a predetermined period of time lapsing with less than a threshold level of movement.

20. The device of claim 18, the program instructions further executable to direct the performance of detecting movement combinations represented by the one or more input signals beginning from a starting position established when an external start signal is received.



124
Sensing Module
128
Movement Sensor
130
Communications Device
Processor
132
134
Memory Medium
124
Sensing Module
128
Movement Sensor
130
Communications Device
Processor
124
132
134
Memory Medium
User Sensory Output Signal
118
114
120
Communications Device
Processor
I/O
Output Mode Selection
112
116
122
Start Trigger
Memory Medium
Timer
Controller

FIG. 1

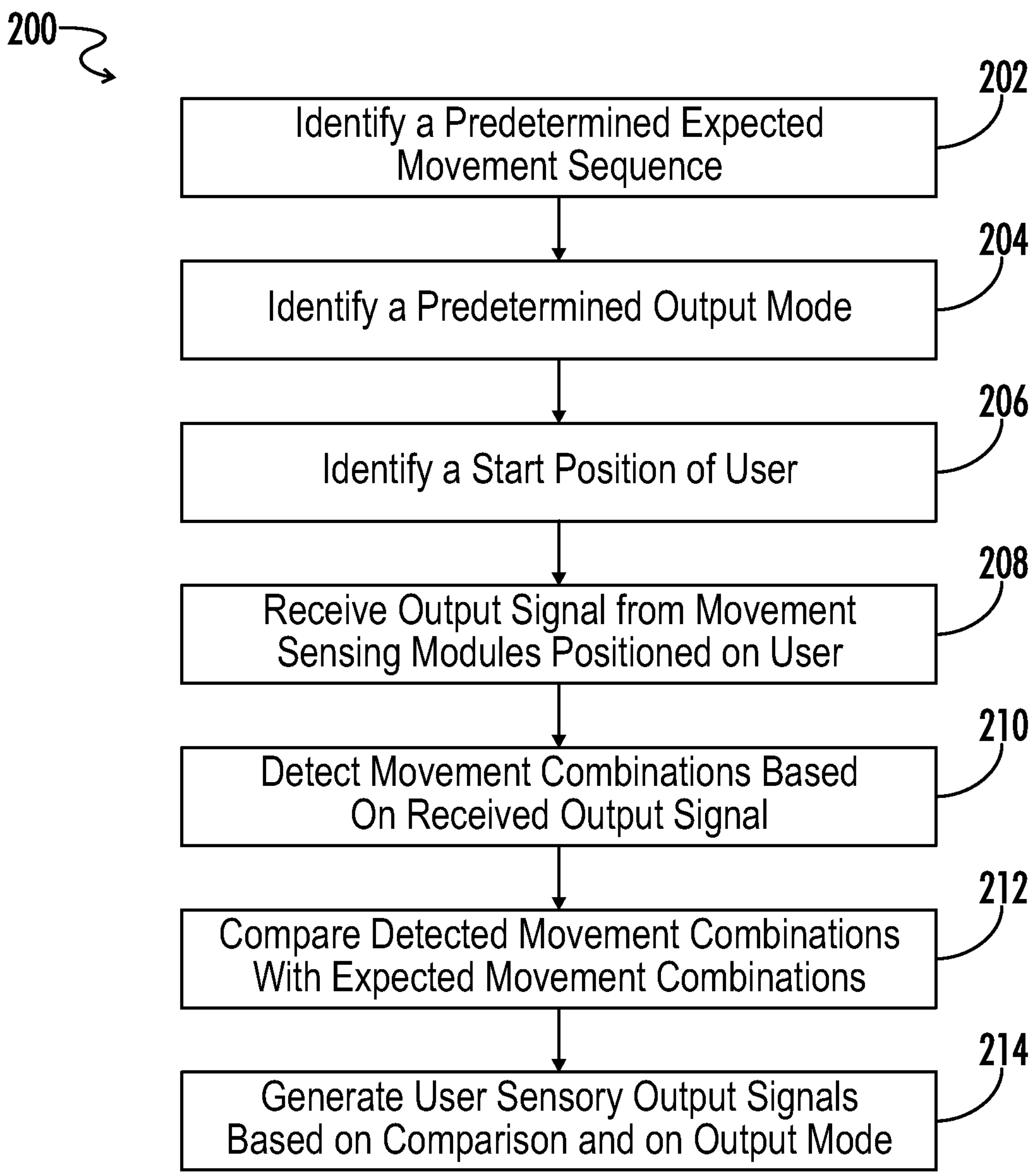

200
202
Identify a Predetermined Expected Movement Sequence
204
Identify a Predetermined Output Mode
206
Identify a Start Position of User
208
Receive Output Signal from Movement Sensing Modules Positioned on User
210
Detect Movement Combinations Based On Received Output Signal
212
Compare Detected Movement Combinations With Expected Movement Combinations
214
Generate User Sensory Output Signals Based on Comparison and on Output Mode

FIG. 2

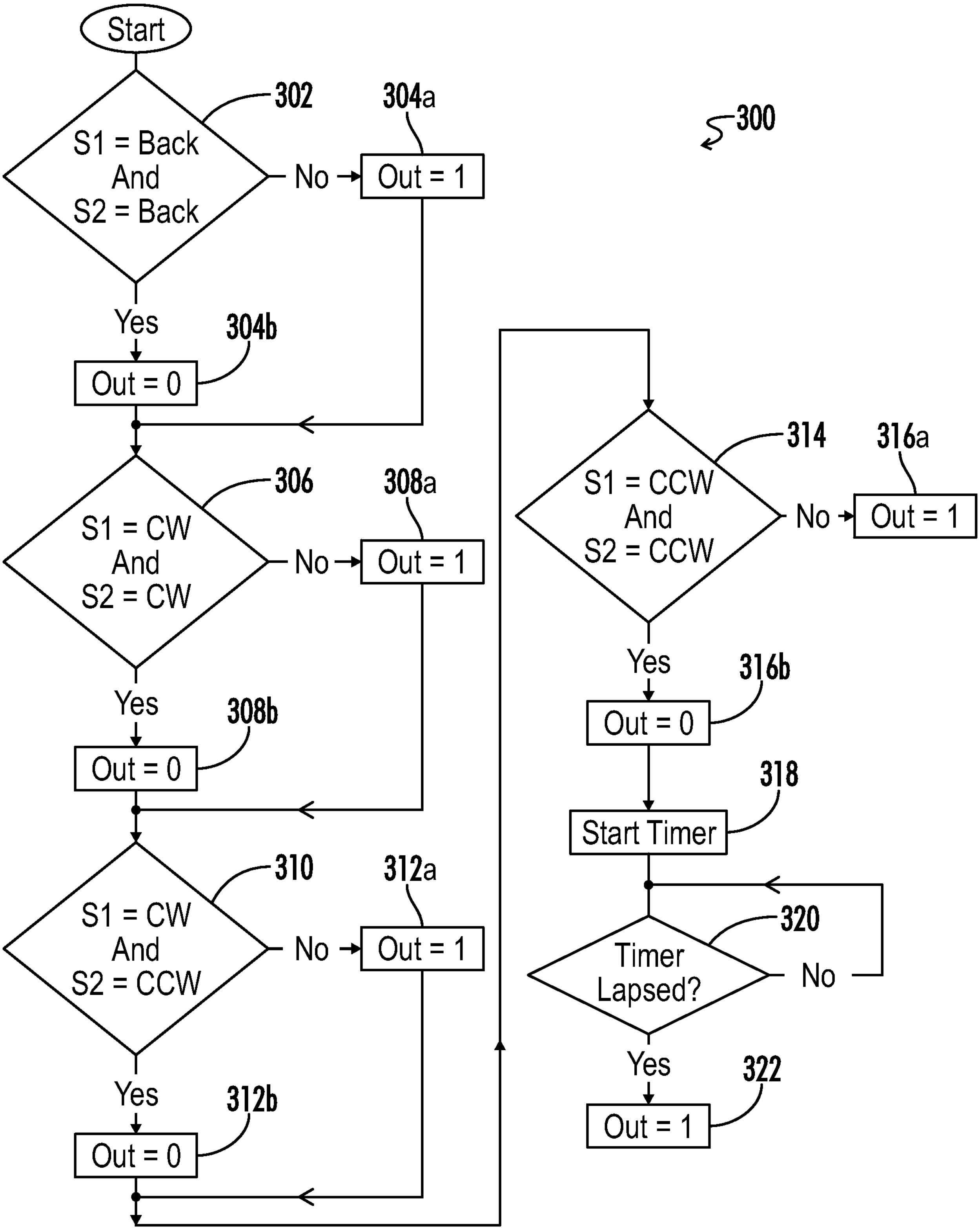

Start
S1 = Back And S2 = Back
302
No
Out = 1
304a
Yes
Out = 0
304b
S1 = CW And S2 = CW
306
Out = 1
308a
Out = 0
308b
S1 = CW And S2 = CCW
310
Out = 1
312a
Out = 0
312b
300
S1 = CCW And S2 = CCW
314
Out = 1
316a
Out = 0
316b
Start Timer
318
Timer Lapsed?
320
Out = 1
322

FIG. 3

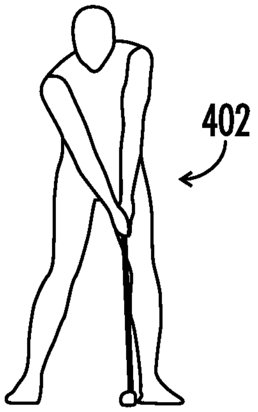


FIG. 4(a)

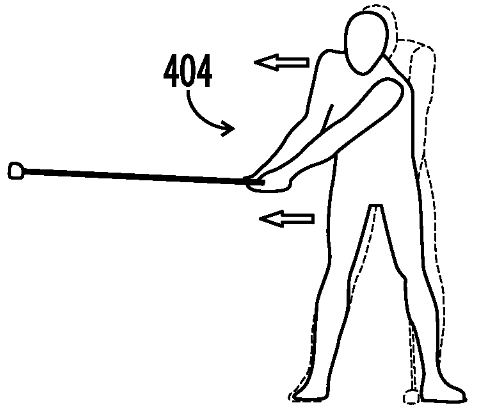


FIG. 4(b)

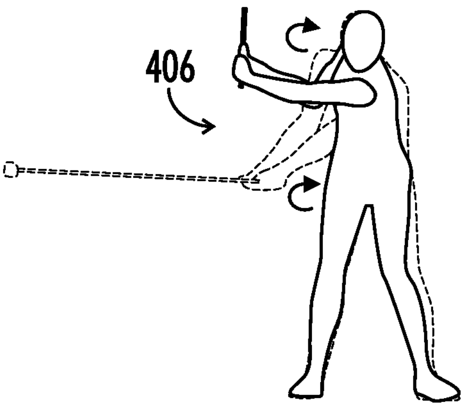


FIG. 4(c)

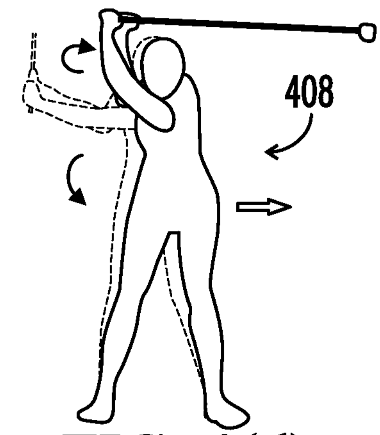


FIG. 4(d)

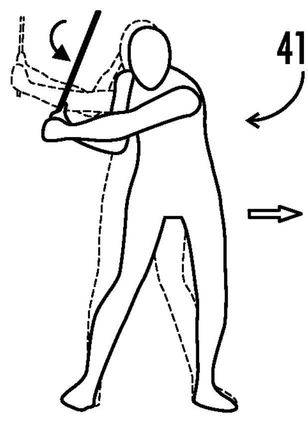


FIG. 4(e)

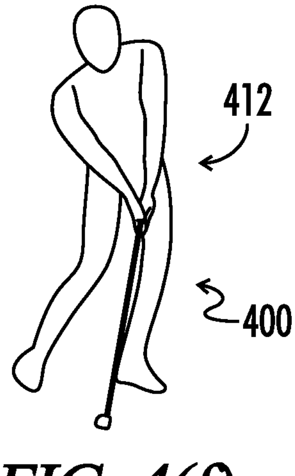


FIG. 4(f)

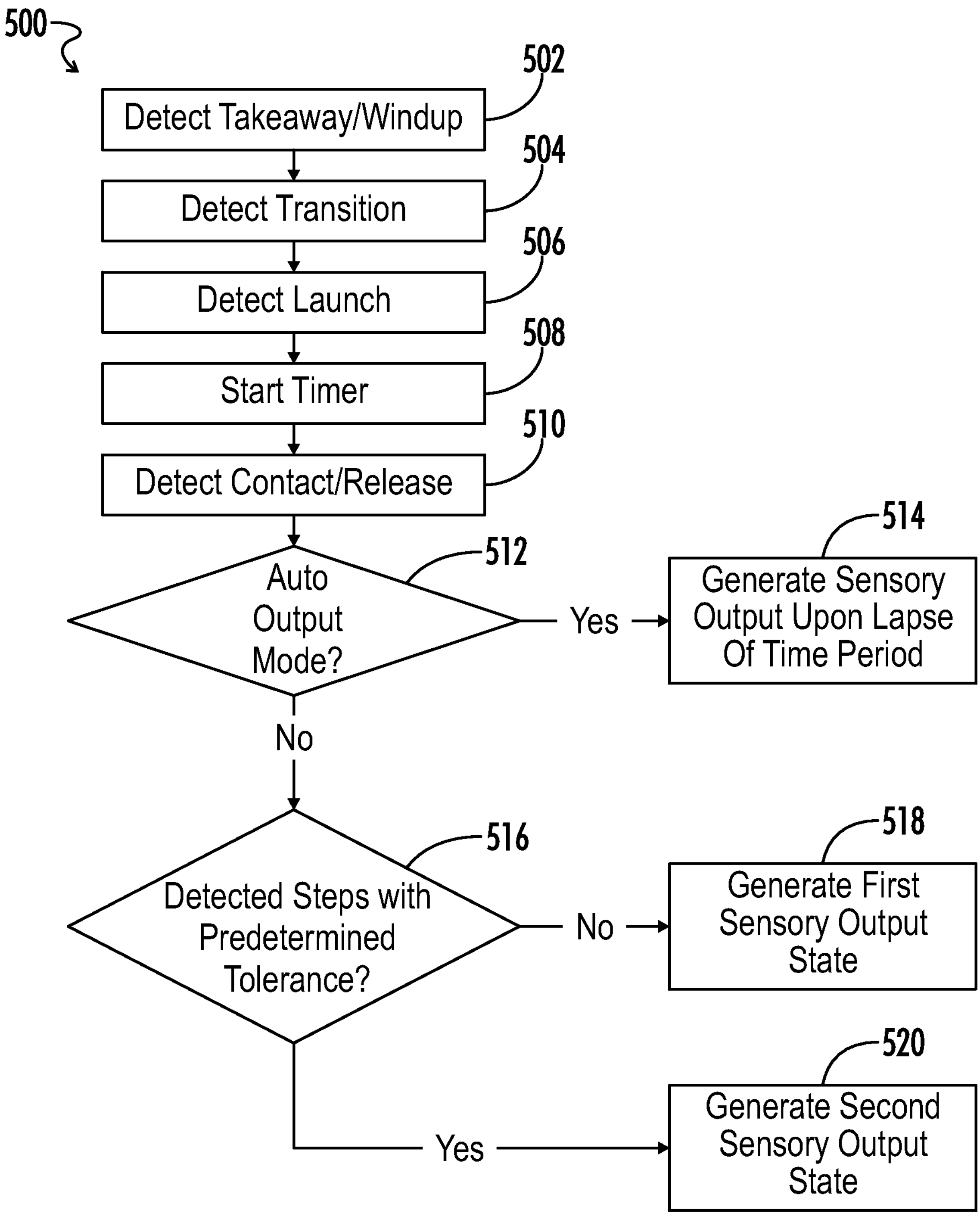

500
502
Detect Takeaway/Windup
504
Detect Transition
506
Detect Launch
508
Start Timer
510
Detect Contact/Release
512
Auto Output Mode?
Yes
514
Generate Sensory Output Upon Lapse Of Time Period
No
516
Detected Steps with Predetermined Tolerance?
No
518
Generate First Sensory Output State
Yes
520
Generate Second Sensory Output State

FIG. 5