US 20140248594A1

(19) **United States**
(12) **Patent Application Publication** (10) Pub. No.: **US 2014/0248594 A1**
        Navas   (43) **Pub. Date: Sep. 4, 2014**

(54) **SMART BOXING GLOVES AND METHODS OF USE**

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(21) Appl. No.: **13/782,001**

(22) Filed: **Mar. 1, 2013**

Publication Classification

(51) **Int. Cl.**
     A63B 69/32   (2006.01)
     A63B 69/00   (2006.01)

(52) **U.S. Cl.**
     CPC *A63B 69/32* (2013.01); *A63B 69/004* (2013.01)
     USPC **434/247**

(57) **ABSTRACT**

A system, for training martial arts comprising a hand mounted accelerometer coupled to a martial arts glove, such as a boxing glove or mixed martial arts (MMA) glove, or a wrist band, operatively coupled to a processor capable of determining user hand position based on data collected from the accelerometer(s). A software routine stored in a computer readable medium and accessible to the system shall comprise the method of converting the data from the accelerometers to positional data of the user's hands. The system may further comprise a remote unit containing the processor and a force sensor mounted to a striking target. The force sensor may also be coupled to the martial arts glove.
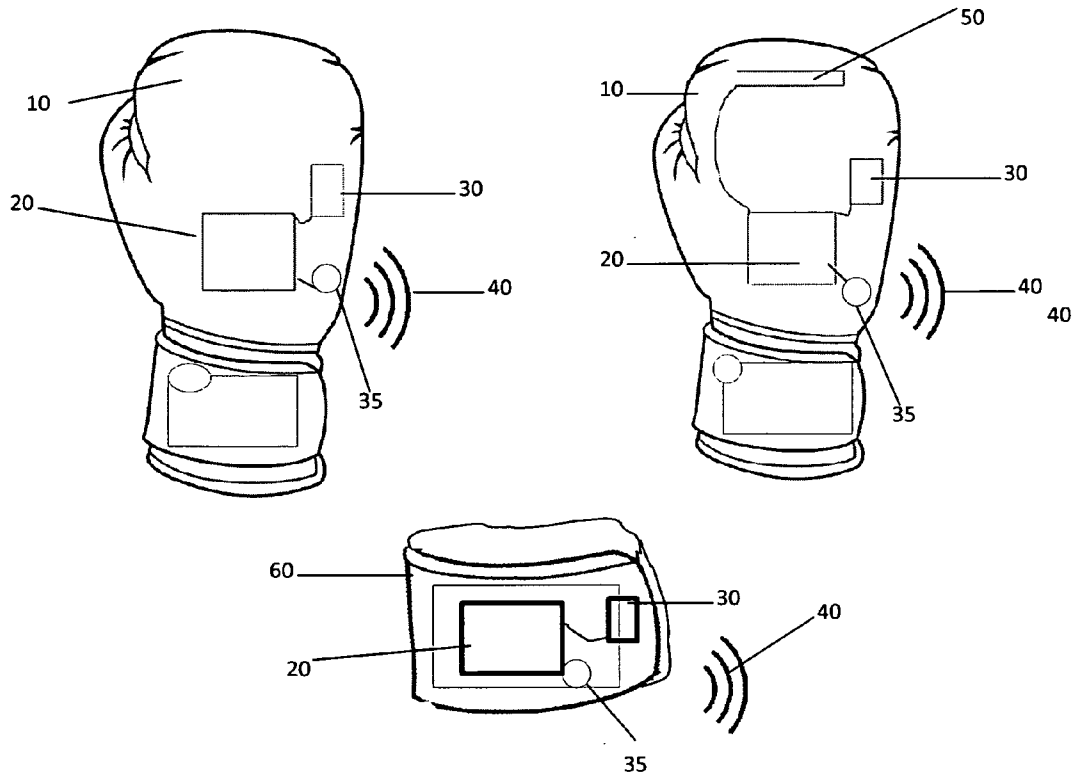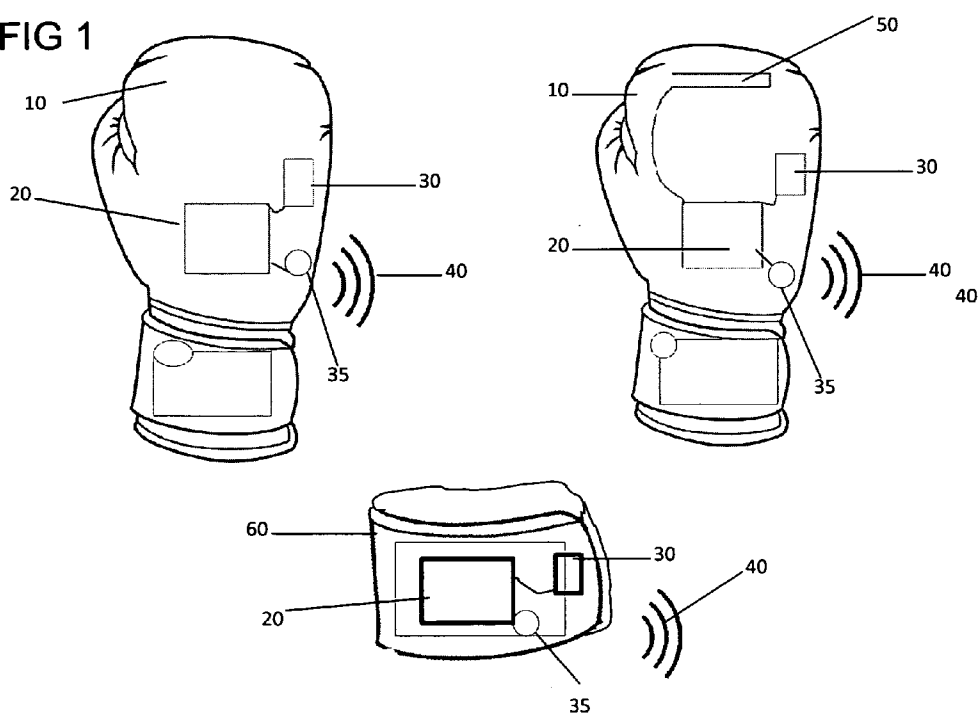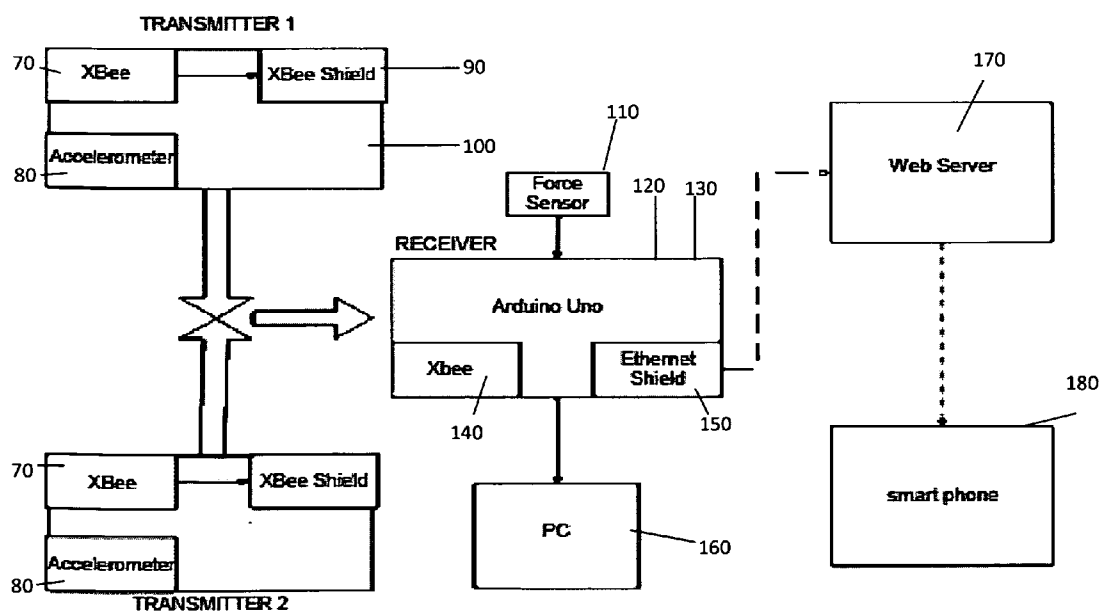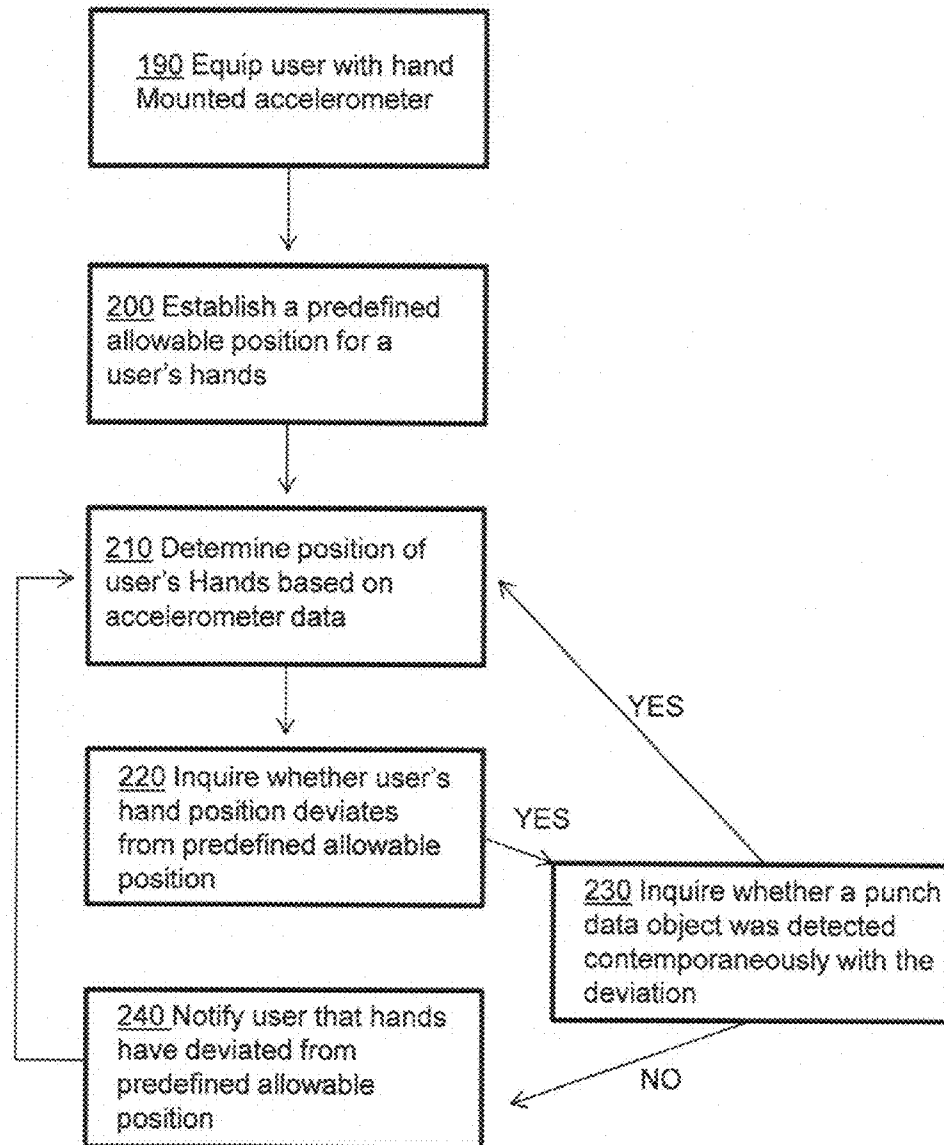
FIG 1

FIG 2

FIG 3

190 Equip user with hand
Mounted accelerometer

200 Establish a predefined
allowable position for a
user's hands

210 Determine position of
user's Hands based on
accelerometer data

220 Inquire whether user's
hand position deviates
from predefined allowable
position

YES

230 Inquire whether a punch
data object was detected
contemporaneously with the
deviation

YES

NO

240 Notify user that hands
have deviated from
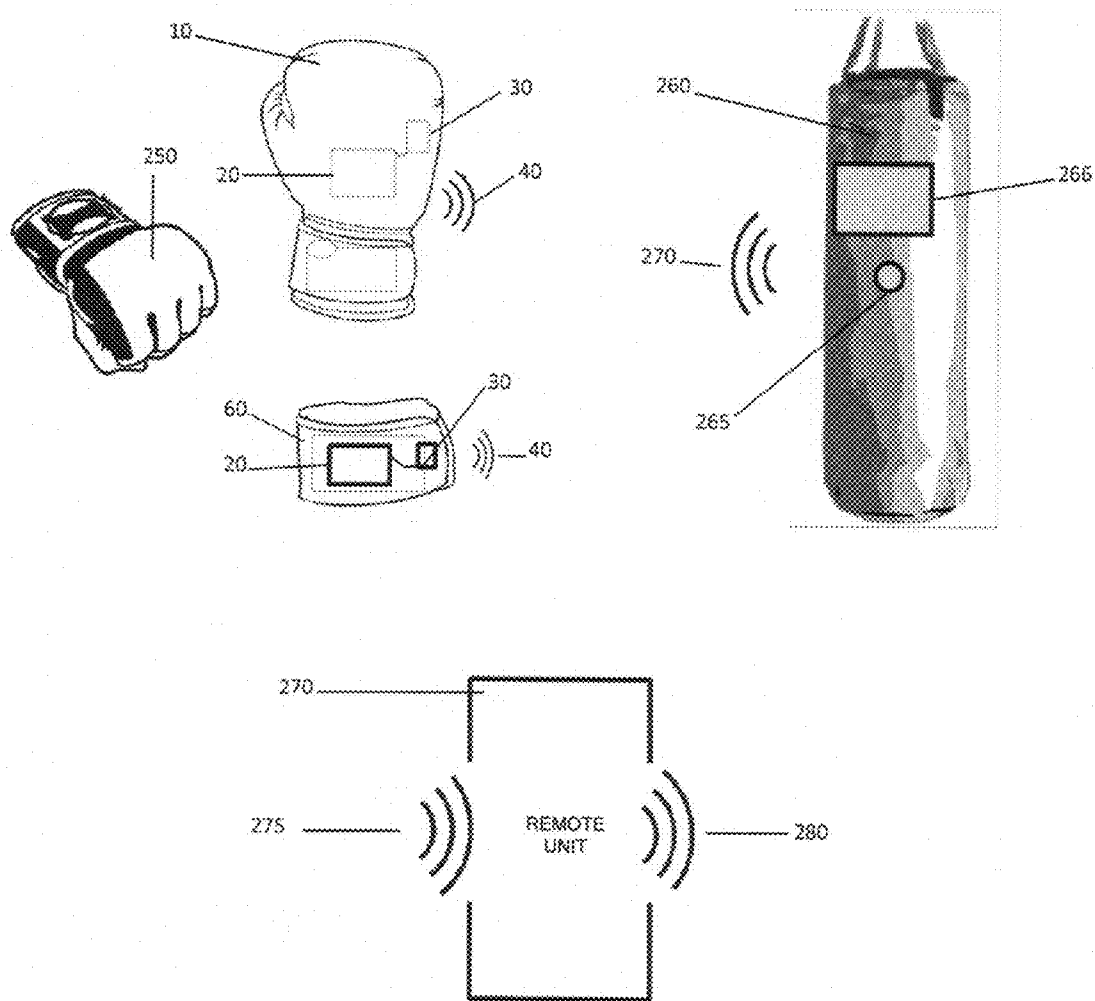predefined allowable
position

FIG 4

SMART BOXING GLOVES AND METHODS OF USE

BACKGROUND

[0001] Combat sports are competitive sports wherein fighters engage each other in hand to hand combat while abiding by defined rules of conduct. There are various forms of combat sports, but boxing and mixed martial arts (MMA) are currently predominant. In a combat sports match, a winner is determined by knockout, winning on points, having thrown more punches and better quality punches (quality being determined by the location of the punch with a blow to the head possessing the most quality) or when a fighter gives up (taps out) Thus, it is a common gal of participants of combat sports to strike each other about the head, neck and face. Combat sports participants are often well trained athletes capable of substantial power and the results of head strikes can be devastating. As a result, it is important for fighters to learn to keep their hands in proper defensive position. Thus, there is a need in the field for systems, devices and methods for monitoring a fighter's proper guard level. There is also a need in the field for systems, devices and methods to improve a fighter's overall performance by keeping track of a fighter's punch count and the force of each punch thrown.

SUMMARY

[0002] In an embodiment, a device is provided that comprises at least one accelerometer adapted to worn on the hand or wrist of a user. The accelerometer(s) are operatively coupled to a processor capable of calculating the user's hand position based on data from the accelerometer(s). The at least one accelerometer may be built into a boxing glove or a wrist band. The processor may be operatively coupled to a notifier, such as a speaker or light, that would indicate to a user when his or her hands deviated from a predefined allowable position. The software used to analyze the data from the accelerometers may also have the capability to differentiate intended deviations (punches) from unintended deviations.

[0003] In another embodiment, the invention of the present disclosure is a system for training boxing where a user wears at least one smart boxing glove comprising a glove portion, and an accelerometer capable of providing data about the glove's position in space. Data from the gloves is analyzed and processed in order to determine the glove's position in space and compare it against a predefined allowable position. The system would also have functionality to notify a user when his or her hands deviate from the predefined allowable position. The software used to analyze the data from the accelerometers may also have the capability to differentiate intended deviations (punches) from unintended deviations.

[0004] In another embodiment the invention of the present disclosure is a method for training combat athletes to keep their hands in proper guard position. The method comprises the steps of equipping a user with at least one smart boxing glove, calibrating the user's hand position through the action of analyzing data from accelerometers within the glove, defining an allowable position for the user's hands and an allowable variance, comparing the user's hand position to the defined allowable position and notifying the user if his or her hands are out of proper defensive position. The software used to analyze the data from the accelerometers may also have the capability to differentiate intended deviations (punches) from unintended deviations.

BRIEF DESCRIPTION OF THE DRAWINGS

[0005] FIG. 1: Devices

[0006] FIG. 2: Schematic Diagram of the Device

[0007] FIG. 3: Schematic Representation of the Method

[0008] FIG. 4: System

DETAILED DESCRIPTION

Device

[0009] In one embodiment the device comprises a martial arts glove (10) such as a boxing or MMA glove further comprising a glove portion. The device further comprises at least one accelerometer (30) coupled with the glove (10) and a processor (20) operatively coupled to the accelerometer (30). The output data from the accelerometers (30) can be fed into the processor (20) in order to determine the position of the user's hands. By placing capacitors on each of the accelerometers' X, Y, Z outputs, the accelerometers' output(s) may be stabilized. The glove may further comprise at least one force sensor (50) operatively coupled to the processor (20). Each glove may further comprise a wireless transmitter (35) capable of transmitting (40) data from the accelerometers and/or the force sensor(s). Analog to digital converters may be used to convert the analog signals from the accelerometers into digital signals. A control interface such as a keypad or touch screen may be included on the glove to allow a user to control the gloves, view data and or enter information. A display such as an LCD screen may be used to display data to a user. A notifying element may be present on the glove to communicate information to a user. For example, a light or sound may be triggered when the user's hands move outside a predefined threshold. The force sensor(s) (50) and accelerometer(s) (30) may be positioned in any appropriate location in or on the device. The force sensor (50) may be coupled to the front face of the glove (10) and the accelerometer (30) may be located on the side to protect it once the user begins throwing strikes.

[0010] In another embodiment the device comprises a wrist band comprising a wrist engaging portion (60). The wrist engaging portion may be any configuration that anchors the wrist band device to the wrist of the user. For example, an elastic textile velcro strap. The wrist engaging portion (60) may be sized to accommodate fitting over the cuff portion of a martial arts glove. The wrist band further comprises at least one accelerometer (30) coupled with the wrist band and a processor operatively (20) coupled to the accelerometer. The output data from the accelerometers can be fed into the processor in order to determine the position of the user's hands. By placing capacitors on each of the accelerometers' X, Y, Z outputs, the accelerometers output(s) may be stabilized. The wrist band may further comprise at least one force sensor operatively coupled to the processor. Each wrist band may further comprise a wireless transmitter (35) capable of transmitting (40) data from the accelerometers (30) and/or the force sensor(s). Analog to digital converters may be used to convert the analog signals from the accelerometers into digital signals. A control interface such as a keypad or touch screen may be included on the wrist band to allow a user to control the devices, view data and or enter information. A display such as an LCD screen may be used to display data to a user. A notifying element may be present on the wrist band to communicate information to a user. For example, a light or

sound may be triggered when the user's hands move outside a predefined allowable position.

[0011] FIG. 2 shows a schematic representation of an embodiment of the device. There are two accelerometers (80) placed on the fighter's hands, one on the left hand and one on the right hand. The accelerometers are connected to an Xbee shield (90) which is connected to an Arduino Lilypad (100). The analog data read from the accelerometer is input to the Arduino Lilypad. The Arduino Lilypad then sends the data to the Arduino Uno via the Xbee radio (70). The XBees, the Arduino LilyPads and the accelerometers makes up the transmitter module of the system. The Arduino Uno board has an Xbee radio with a chip antenna that acts a receiver. This antenna receives the data from the Xbee shield (90) and handles incoming signals from both hands. This configuration comprises the wireless portion of the system.

[0012] The Arduino Uno board (120) may be connected to a computer via USB and may also have a force sensor (110) connected to it via an analog pin of the board. The force sensor may act as a target for the user to strike. Alternatively force sensor may be attached to each hand. All the information delivered by the transmitters is processed in the Arduino Uno (120) and displayed on a computer screen. The computer (160) other appropriate data processing means is needed to write the sketch or program that is going to run on the Arduino board (120) and to monitor the sensor data.

[0013] The glove subsystem is placed on each of the fighters hands, one on his left hand and one on his right hand. The glove subsystem is composed of a LilyPad Accelerometer (ADXL335) (80) connected to an XBee shield (90) and Arduino LilyPad (100). An XBee shield is an adapter that mounts an XBee radio and enables connectivity with another device. Analog data read from the accelerometer is input to the Arduino Lilypad. The data obtained from the accelerometer is used to monitor the guard level. The LilyPad Arduino processes this data and verifies that the fighter's hands are within a certain threshold. If the threshold is exceeded a hands down warning signal to the base station via the XBee radio. An LED is illuminated and a buzzer is sounded by the base station when the warning signal is received.

System

[0014] In an embodiment a system for training a user to maintain a desired hand position comprises a device for measuring the position of a user's hands in space, a processor to monitor the position of the user's hands in space and compare the user's hand position to a predefined allowable position, and a signal producer to notify the user when the user's hands depart from an allowable position.

[0015] The device for measuring the position of the user's hands may comprise a martial arts glove (10) such as a boxing or MMA (250) glove to which is operatively coupled at least one accelerometer (30) capable of providing data sufficient to calculate the position of the user's hands. Alternatively, the device may be a wrist band (60) adapted to fit over the wrist of a user to which is operatively coupled an accelerometer (30) capable of providing data sufficient to calculate the position of the user's hands.

[0016] The system may further comprise a processor (20) operatively coupled to the at least one accelerometer (30) capable of analyzing data from the at least one accelerometer (30), calculating the user's hand position based on the data, and communicating the data to other components of the system. The system may further comprise a force sensor. The

force sensor may be coupled to the device mounted to the user's hand or wrist. Alternatively the force sensor may be mounted on an external target (260). The force sensor will be operatively coupled to the processor (20). The coupling may be accomplished wirelessly. The system may further comprise a transmitter (265) capable of transmitting data from the at least one accelerometer and/or the force sensor.

[0017] A software routine stored in a computer readable medium and accessible to the system shall comprise the method of converting the data from the accelerometers to positional data of the user's hands.

[0018] The system may further comprise a remote unit (270). The remote unit may further comprise a receiver (275) for receiving signals from the at least one accelerometer and/or the force sensor. The remote unit may further comprise a processor. The remote unit may further comprise a transmitter (280) in order to transmit data to other objects such as a smart phone, a personal computer or the cloud. The remote unit may further comprise a user interface further comprising an input device such as a key pad and a display such as an LCD screen.

[0019] The system may further comprise a target (260). The target may comprise any suitable striking surface and may take the form of a punching bag, a heavy bag, a muay thai bag, a grappling dummy, focus mitts, wall mounted targets, or the like. The target may further comprise a force sensor (266) capable of measuring the force of strikes. The force sensor should be operatively coupled to the processor.

[0020] A signal from the accelerometers in the gloves may indicate that the user's hands have deviated from the allowable position. This may be due to poor form or the user may be throwing a punch. In order to determine which, the system checks to see if there was activity in the force sensor indicative of a punch (punch data object.) If a punch data object is detected no warning signal is sent to the user.

[0021] Based on the inherent properties and capabilities of the system, various additional functionality can be a part of the system. For example, timing a workout, counting punches, creating a punch log, creating graphical representations of workout data, storing workout data, and sharing workout data between devices and systems.

Method

[0022] In another embodiment, a method for training boxing or other martial arts comprising the steps of equipping (190) or providing a user with a least one hand mounted accelerometer and determining the position of the user's hands and/or arms based on data collected from the at least one accelerometer (logging initial coordinates). The accelerometer should be one capable of providing positional data about the position of the accelerometer in space. The at least one accelerometer, may be disposed within, on top of or in some other way coupled to a martial arts glove such as a boxing glove or MMA glove. The at least one accelerometer may also be provided as coupled to a wrist band adapted to fit around the wrist of a user. The method may further comprise the step of establishing (200) a predefined allowable position for the user's hands. The method may further comprise the step of defining an acceptable amount of variance from the predefined allowable position. The acceptable amount of variance may be designed to represent the hand positioning considered ideal for protecting the user's head area. The acceptable amount of variance would allow for small deviations from the ideal hand position during workouts. The

method may further comprise the step of collecting data from the at least one accelerometer and using the collected data to calculate the user's hand position (210), and then comparing (220) that hand position against the predefined allowable position. The method may further comprise the step of notifying (240) the user if the user's hands have deviated beyond the acceptable amount of variance from the predefined allowable position. The notification may be accomplished by auditory, visual or haptic signal, such as vibration.

[0023] A signal from the accelerometers in the gloves may indicate that the user's hands have deviated from the allowable position. This may be due to poor form or the user may be throwing a punch. In order to determine which, the system inquires (230) whether there was activity in the force sensor indicative of a punch (punch data object.) If a punch data object is detected no warning signal is sent to the user.

[0024] With respect to the above, it is to be understood that the invention is not limited in its application to the details of construction and to the arrangement of the components listed or the steps set forth in the description or illustrated in the drawings. The various apparatus and methods of the disclosed invention are capable of other embodiments, and of being practiced and carried out in various ways that would be readily known to those skilled in the art, given the present disclosure. Further, the terms and phrases used herein are for descriptive purposes and should not be construed as in any way limiting.

[0025] As such, those skilled in the art will appreciate that the conception upon which this disclosure is based by be utilized as a basis for designing other inventions with similar properties. It is important therefore that the embodiments, objects, and claims herein, be regarded as including such equivalent construction and methodology insofar as they do not depart from the spirit and scope of the present invention.

[0026] It should be noted that the components in the figures are not necessarily to scale, emphasis instead being placed upon illustrating the principles of the invention. Moreover, in the figures, like reference numerals designate corresponding parts throughout the different views. However, like parts do not always have like reference numerals. Moreover, all illustrations are intended to convey concepts, where relative sizes, shapes and other detailed attributes may be illustrated schematically rather than literally or precisely.

[0027] All documents mentioned herein are hereby incorporated in their entirety by reference. References to items in the singular should be understood to include items in the floral, and vise versa, unless explicitly stated otherwise or clear from the text. Grammatical conjunctions are intended to express any and all disjunctive and conjunctive combinations of conjoined clauses, sentences, words, and the like, unless otherwise stated or clear from context

I claim:

1. A system comprising:
    at least one accelerometer adapted to be worn on the hand or wrist of a user; and

a processor operatively coupled to the at least one accelerometer capable of calculating the user's hand position based on data from the accelerometer.

2. The system of claim 1 where the accelerometer is coupled to a martial arts glove.

3. The system of claim 1 where the accelerometer is coupled to a wrist band.

4. The system of claim 1 further comprising a force sensor.

5. The system of claim 1 further comprising a transmitter.

6. The system of claim 5 further comprising a remote unit comprising a receiver for receiving data from the transmitter and processor.

7. The system of claim 6 further comprising a transmitter to communicate with other devices.

8. The system of claim 6 further comprising a target, the target further comprising a force sensor operatively coupled to the remote unit.

9. A martial arts glove comprising:
    a glove portion; and
    at least one accelerometer coupled to the glove portion capable of providing positional data about the glove.

10. The martial arts glove of claim 9 further comprising a force sensor coupled to the glove.

11. The martial arts glove of claim 9 further comprising a wireless transmitter capable of transmitting data from the accelerometer.

12. The martial arts glove of claim 9 further comprising a processor operatively coupled to the accelerometer and the transmitter.

13. A wrist band comprising:
    a wrist mounting portion; and
    at least one accelerometer coupled to the wristband capable of providing positional data about the wrist band.

14. The wrist band of claim 13 further comprising a transmitter capable of transmitting data from the accelerometer.

15. A method for training boxers comprising:
    equipping a user with at least one hand mounted accelerometer capable of providing positional data; and
    determining the location of the user's hands by collecting and processing data from the accelerometer.

16. The method of claim 15 further comprising the step of establishing a predefined allowable position for the user's hands.

17. The method of claim 16 further comprising the step of defining an acceptable amount of variance from a predefined allowable position.

18. The method of claim 16 further comprising the step of comparing a user's hand position against a predefined allowable hand position.

19. The method of claim 17 further comprising the step of inquiring whether a punch data object was detected contemporaneously with the signal indicating the user's hands had deviated from the predefined allowable position.

20. The method of claim 16 further comprising the step of notifying the user if the user's hands have deviated beyond the predefined allowable position.

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