US006059576C1

(12) EX PARTE REEXAMINATION CERTIFICATE (10541st)

United States Patent
Brann

(10) Number: US 6,059,576 C1
(45) Certificate Issued: Mar. 17, 2015

(54) **TRAINING AND SAFETY DEVICE, SYSTEM AND METHOD TO AID IN PROPER MOVEMENT DURING PHYSICAL ACTIVITY**

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Reexamination Request:
No. 90/013,201, Apr. 4, 2014

Reexamination Certificate for:
Patent No.: **6,059,576**
Issued: **May 9, 2000**
Appl. No.: **08/976,228**
Filed: **Nov. 21, 1997**

(51) **Int. Cl.**
A61B 5/11 (2006.01)
A63B 24/00 (2006.01)

(52) **U.S. Cl.**
CPC ***A61B 5/1116*** (2013.01); *A63B 2220/40* (2013.01); *Y10S 482/901* (2013.01)
USPC **434/247**; 600/595; 482/8; 482/901; 702/101; 601/34

(58) **Field of Classification Search**
None
See application file for complete search history.

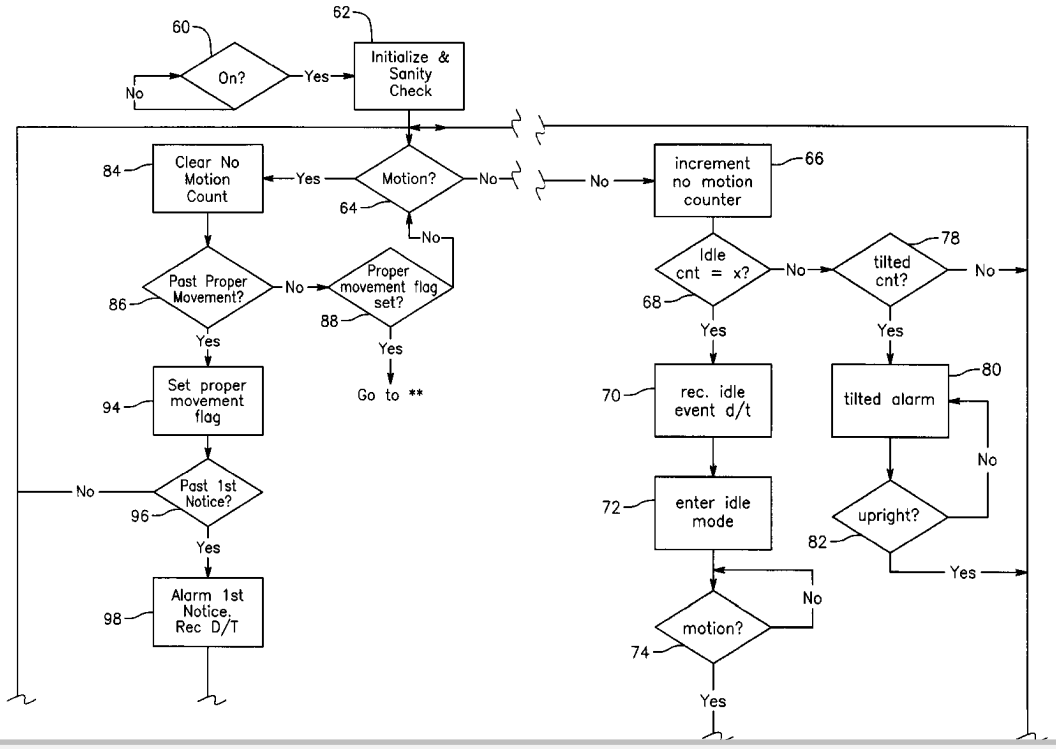
(56) **References Cited**

To view the complete listing of prior art documents cited during the proceeding for Reexamination Control Number 90/013,201, please refer to the USPTO's public Patent Application Information Retrieval (PAIR) system under the Display References tab.

Primary Examiner — Danton DeMille

(57) **ABSTRACT**

An electronic device, system and method to monitor and train an individual on proper motion during physical movement. The system employs an electronic device which tracks and monitors an individual's motion through the use of an accelerometer capable of measuring parameters associated with the individual's movement. The device also employs a user-programmable microprocessor which receives, interprets, stores and responds to data relating to the movement parameters based on customizable operation parameters, a real-time clock connected to the microprocessor, memory for storing the movement data, a power source, a port for downloading the data from the device to other computation or storage devices contained within the system, and various input and output components. The downloadable, self-contained device can be worn at various positions along the torso or appendages being monitored depending on the specific physical task being performed. The device also detects the speed of movements made while the device is being worn. When a preprogrammed recordable event is recognized, the device records the time and date of the occurrence while providing feedback to the wearer via visual, audible and/or tactile warnings.



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THE PATENT IS HEREBY AMENDED AS INDICATED BELOW.

Matter enclosed in heavy brackets [ ] appeared in the patent, but has been deleted and is no longer a part of the patent; matter printed in italics indicates additions made to the patent.

AS A RESULT OF REEXAMINATION, IT HAS BEEN DETERMINED THAT:

Claims **1**, **13** and **20** are determined to be patentable as amended.

Claims **2-12**, **14-19** and **21-29**, dependent on an amended claim, are determined to be patentable.

New claims **30-185** are added and determined to be patentable.

1. A portable, self-contained device for monitoring movement of body parts during physical activity, said device comprising:

a movement sensor capable of measuring data associated with unrestrained movement in any direction and generating signals indicative of said movement;

a power source;

a microprocessor connected to said movement sensor and to said power source, said microprocessor capable of receiving, interpreting, storing and responding to said movement data based on user-defined operational parameters, *detecting a first user-defined event based on the movement data and at least one of the user-defined operational parameters regarding the movement data, and storing first event information related to the detected first user-defined event along with first time stamp information reflecting a time at which the movement data causing the first user-defined event occurred*:

at least one user input connected to said microprocessor for controlling the operation of said device;

a real-time clock connected to said microprocessor; memory for storing said movement data; and

an output indicator connected to said microprocessor for signaling the occurrence of user-defined events;

wherein said movement sensor measures the angle and velocity of said movement.

13. A system to aid in training and safety during physical activity, said system comprising

a portable, self-contained movement measuring device, said movement measuring device further comprising

a movement sensor capable of measuring data associated with unrestrained movement in any direction and generating signals indicative of said movement;

a power source;

a microprocessor connected to said power source, said microprocessor capable of receiving, interpreting, storing and responding to said movement data based on user-defined operational parameters, *detecting a first user-defined event based on the movement data and at least one of the user-defined operational parameters regarding the movement data, and storing first event information related to the detected first user-defined event along with first time stamp information reflecting a time at which the movement data causing the first user-defined event occurred;*

at least one user input connected to said microprocessor for controlling the operation of said device;

a real-time clock connected to said microprocessor; memory for storing said movement data;

at least one input/output port connected to said microprocessor for downloading said data and uploading said operational parameters; and

an output indicator connected to said microprocessor;

a computer running a program capable of interpreting and reporting said movement data based on said operational parameters; and

a download device electronically connected to said movement measuring device and said computer for transmitting said movement data and operational parameters between said movement measuring device and said computer for analysis, reporting and operation purposes;

wherein said movement sensor measures the angle and velocity of said movement.

20. A method to monitor physical movement of a body part comprising the steps of:

attaching a portable, self-contained movement measuring device to said body part for measuring unrestrained movement in any direction;

measuring data associated with said physical movement; interpreting, *using a microprocessor included in the portable, self-contained movement measuring device,* said physical movement data based on user-defined operational parameters and a real-time clock; **[**and**]**

storing said data in memory;

detecting, using the microprocessor, a first user-defined event based on the movement data and at least one of the user-defined operational parameters regarding the movement data; and

storing, in said memory, first event information related to the detected first user-defined event along with first time stamp information reflecting a time at which the movement data causing the first user-defined event occurred.

30. The device of claim 1, wherein said microprocessor is configured to store, in said memory, date information associated with the first time stamp information.

31. The device of claim 1, wherein said microprocessor is configured to retrieve said first time stamp information from said real-time clock and associate the retrieved first time stamp information with said first user-defined event.

32. The device of claim 31, wherein said microprocessor is configured to retrieve said first time stamp information from said real-time clock based on the detection of the user-defined event.

33. The device of claim 1, wherein said memory is configured to continue to store said movement data in response to battery power being lost from said power source.

34. The device of claim 1, wherein said movement sensor is configured to continuously check for said movement.

35. The device of claim 34, wherein said microprocessor is configured to continuously interpret, based on the user-defined operational parameters, said movement data received from said movement sensor.

36. The device of claim 1, wherein said output indicator is configured to display information signaling the occurrence of

37. The device of claim 36, wherein said output indicator is configured to display said information signaling the occurrence of the first user-defined event based on said first time stamp information.

38. The device of claim 1, wherein said output indicator is configured to display information signaling the occurrence of the first user-defined event based on the detection of the first user-defined event and the first time stamp information.

39. The device of claim 1, wherein said at least one of the user-defined operational parameters is a predetermined threshold, and said first user-defined event occurs when the movement data reaches the predetermined threshold.

40. The device of claim 39, wherein said output indicator is configured to display information signaling the occurrence of the first user-defined event when the movement data reaches the predetermined threshold.

41. The device of claim 39, wherein said memory is configured to store said first event information indicating that the predetermined threshold is met.

42. The device of claim 41, wherein said memory is configured to store the first time stamp information in association with said first event information.

43. The device of claim 1, wherein said output indicator is configured to indicate a low battery condition of the device.

44. The device of claim 9, wherein said output indicator is selected from the group consisting of single monochromatic LEDs, multiple colored lights, and liquid crystal displays.

45. The device of claim 1, wherein said movement data stored in the memory is configured to be downloaded to a computer.

46. The device of claim 45, further comprising:

software configured to communicate with external software, wherein the external software is configured to present the downloaded movement data to the user.

47. The device of claim 46, wherein said external software is configured to run on the computer.

48. The device of claim 47, wherein said downloaded movement data is configured to be analyzed by said user via said external software.

49. The device of claim 46, wherein said external software is configured to interpret said movement data and produce at least one report.

50. The device of claim 46, wherein said external software is configured to interpret said movement data and produce at least one history report.

51. The device of claim 50, wherein said at least one history report includes dates and times of said movement data.

52. The device of claim 46, wherein said external software is configured to allow the user to program additional reports and histories with respect to said movement data of said user.

53. The device of claim 45, wherein said movement data is configured to be downloaded to said computer via a wired connection.

54. The device of claim 45, wherein said movement data is configured to be downloaded to said computer via a wireless connection.

55. The device of claim 39, wherein the output indicator is configured to provide a visual indicator to the user regarding the predetermined threshold being reached.

56. The device of claim 1, wherein the memory is configured to store the user-defined operational parameters, the user-defined operational parameters comprising a plurality of thresholds respectively corresponding to a plurality of notifications, wherein each time the movement data reaches one of the plurality of the thresholds, the microprocessor is

57. The device of claim 56, wherein when the microprocessor detects that one of the user-defined events occurred based on the movement data reaching one of the plurality of the thresholds, the output indicator displays a corresponding one of the notifications indicating that one of the user-defined events has occurred.

58. The device of claim 56, wherein the plurality of thresholds are different from each other.

59. The device of claim 56, wherein the plurality of notifications are different visual indicators.

60. The device of claim 59, wherein at least one of the visual indicators includes a blinking indicator.

61. The device of claim 39, wherein said microprocessor is configured to detect occurrence of the first user-defined event by comparing said movement data to said predetermined threshold.

62. The device of claim 1, wherein said device is configured to be placed on said user's arm to monitor and record said movement data.

63. The device of claim 62, wherein said movement sensor is configured to measure movement of said user's arm.

64. The device of claim 1, wherein said movement sensor is configured to measure a walking distance.

65. The device of claim 64, wherein said device is configured to be wearable by the user, and said movement sensor is configured to measure said walking distance of said user.

66. The device of claim 1, wherein said microprocessor is configured to store, in said memory, date information associated with the first time stamp information,

wherein said movement sensor is configured to continuously check for said movement,

wherein said output indicator is configured to display information signaling the occurrence of the first user-defined event based on the detection of the first user-defined event and the first time stamp information,

wherein the device further comprises software configured to communicate with external software configured to run on a computer and present the downloaded movement data,

wherein said external software is configured to produce at least one report based on said movement data,

wherein the memory is configured to store the user-defined operational parameters, the user-defined operational parameters comprising a plurality of thresholds respectively corresponding to a plurality of notifications, wherein each time the movement data reaches one of the plurality of the thresholds, the microprocessor is configured to detect that one of the user-defined events occurred,

wherein said device is configured to be placed on said user's arm to monitor and record said movement data,

wherein said movement sensor is configured to measure movement of said user's arm.

67. The system of claim 13, wherein said microprocessor is configured to store, in said memory, date information associated with the first time stamp information.

68. The system of claim 13, wherein said microprocessor is configured to retrieve said first time stamp information from said real-time clock and associate the retrieved first time stamp information with said first user-defined event.

69. The system of claim 68, wherein said microprocessor is configured to retrieve said first time stamp information from said real-time clock based on the detection of the first user-defined event.

70. The system of claim 13, wherein said memory is con-

71. The system of claim 13, wherein said movement sensor is configured to constantly checks for said movement.

72. The system of claim 71, wherein said microprocessor is configured to continuously interpret, based on the user-defined operational parameters, said movement data received from said movement sensor.

73. The system of claim 13, wherein said output indicator is configured to display information signaling the occurrence of the first user-defined event based on the detection of the first user-defined event.

74. The system of claim 73, wherein said output indicator is configured to display said information signaling the occurrence of the first user-defined event based on said first time stamp information.

75. The system of claim 13, wherein said output indicator is configured to display information signaling the occurrence of the first user-defined event based on the detection of the first user-defined event and the first time stamp information.

76. The system of claim 13, wherein said at least one of the user-defined operational parameters is a predetermined threshold, and said first user-defined event occurs when the movement data reaches the predetermined threshold.

77. The system of claim 76, wherein said output indicator is configured to display information signaling the occurrence of the first user-defined event when the movement data reaches the predetermined threshold.

78. The system of claim 78, wherein said memory is configured to store said first event information indicating that the predetermined threshold is met.

79. The system of claim 78, wherein said memory is configured to store the first time stamp information in association with said first event information.

80. The system of claim 13, wherein said output indicator is configured to indicate a low battery condition of the device.

81. The system of claim 13, wherein said output indicator is visual, and said output indicator is selected from the group consisting of single monochromatic LEDs, multiple colored lights, and liquid crystal displays.

82. The system of claim 13, wherein said movement data stored in the memory is configured to be downloaded to the computer.

83. The system of claim 82, wherein the portable, self-contained movement measuring device further comprises:

software configured to communicate with the program running on the computer, wherein the program is configured to present the downloaded movement data to the user.

84. The system of claim 83, wherein said downloaded movement data is configured to be analyzed by said user via said program.

85. The system of claim 83, wherein said program is configured to interpret said movement data and produce at least one report.

86. The system of claim 83, wherein said program is configured to interpret said movement data and produce at least one history report.

87. The system of claim 86, wherein said at least one history report includes dates and times of said movement data.

88. The system of claim 83, wherein said program is configured to allow the user to program additional reports and histories with respect to said movement data of said user.

89. The system of claim 82, wherein said movement data is configured to be downloaded to said computer, using the download device, via a wired connection.

90. The system of claim 82, wherein said movement data is

91. The system of claim 76, wherein the output indicator is configured to provide a visual indicator to the user regarding the predetermined threshold being reached.

92. The system of claim 13, wherein the memory is configured to store the user-defined operational parameters, the user-defined operational parameters comprising a plurality of thresholds respectively corresponding to a plurality of notifications, wherein each time the movement data reaches one of the plurality of the thresholds, the microprocessor is configured to detect that one of a plurality of user-defined events occurred.

93. The system of claim 92, wherein when the microprocessor detects that one of the user-defined events occurred based on the movement data reaching one of the plurality of the thresholds, the output indicator displays a corresponding one of the notifications indicating that one of the user-defined events has occurred.

94. The system of claim 92, wherein the plurality of thresholds are different from each other.

95. The system of claim 92, wherein the plurality of notifications are different visual indicators.

96. The system of claim 95, wherein at least one of the visual indicators includes a blinking indicator.

97. The system of claim 13, wherein said output indicator is configured to signal the occurrence of user-defined events.

98. The system of claim 76, wherein said microprocessor is configured to detect occurrence of the first user-defined event by comparing said movement data to said predetermined threshold.

99. The system of claim 13, wherein said device is configured to be placed on said user's arm to monitor and record said movement data.

100. The system of claim 99, wherein said movement sensor configured to measure movement of said user's arm.

101. The system of claim 13, wherein said movement sensor configured to measure a walking distance.

102. The system of claim 101, wherein said device is configured to be wearable by the user, and said movement sensor is configured to measure said walking distance of said user.

103. The system of claim 13, wherein said microprocessor is configured to store, in said memory, date information associated with the first time stamp information,

wherein said movement sensor is configured to continuously check for said movement,

wherein said output indicator is configured to display information signaling the occurrence of the first user-defined event based on the detection of the first user-defined event and the first time stamp information,

wherein said movement data stored in the memory is configured to be downloaded to the computer,

wherein the device further comprises software configured to communicate with the program which presents the downloaded movement data,

wherein said program is configured to produce at least one report based on said movement data,

wherein the memory is configured to store the user-defined operational parameters, the user-defined operational parameters comprising a plurality of thresholds respectively corresponding to a plurality of notifications, wherein each time the movement data reaches one of the plurality of the thresholds, the microprocessor is configured to detect that one of the user-defined events occurred,

wherein said device is configured to be placed on said user's arm to monitor and record said movement data,

104. The method of claim 20, further comprising:
storing, in said memory, date information associated with the first time stamp information.
105. The method of claim 20, further comprising:
retrieving said first time stamp information from said real-time clock and associate the retrieved first time stamp information with said first user-defined event.
106. The method of claim 105, further comprising:
retrieving said first time stamp information from said real-time clock based on the detection of the first user-defined event.
107. The method of claim 20, wherein said storing comprises continuously storing said movement data after battery power is lost from a power source of the portable, self-contained movement measuring device.
108. The method of claim 20, further comprising:
continuously monitoring for said physical movement using a movement sensor of the portable, self-contained movement measuring device.
109. The method of claim 108, wherein said interpreting comprises:
continuously interpreting, based on the user-defined operational parameters, said physical movement data.
110. The method of claim 20, further comprising:
displaying, using an output indicator of the portable, self-contained movement measuring device, information signaling the occurrence of the first user-defined event based on the detection of the user-defined event.
111. The method of claim 110, wherein said output indicator displays said information signaling the occurrence of the first user-defined event based on said first time stamp information.
112. The method of claim 20, further comprising:
displaying, using an output indicator included the portable, self-contained movement measuring device, information signaling the occurrence of the first user-defined event based on the detection of the first user-defined event and the first time stamp information.
113. The method of claim 20, wherein said at least one of the user-defined operational parameters is a predetermined threshold, and said first user-defined event occurs when the movement data reaches the predetermined threshold.
114. The method of claim 113, wherein an output indicator of the portable, self-contained movement measuring device displays information signaling the occurrence of the first user-defined event when the movement data reaches the predetermined threshold.
115. The method of claim 113, further comprising:
storing, in said memory, said first event information indicating that the predetermined threshold is met.
116. The method of claim 115, further comprising:
storing, in said memory, the first time stamp information in association with said first event information.
117. The method of claim 20, further comprising:
indicating a low battery condition, using an output indicator of the portable, self-contained movement measuring device.
118. The method of claim 20, wherein said physical movement data stored in the memory is the interpreted physical movement data, and said stored physical movement data is configured to be downloaded to a computer.
119. The method of claim 118, further comprising:
communicating with external software, wherein the external software is configured to present said interpreted physical movement data to the user.
121. The method of 20, further comprising:
producing a report based on said interpreted physical movement data.
122. The method of 119, further comprising:
producing at least one report based on said interpreted physical movement data using the external software.
123. The method of claim 119, further comprising:
producing at least one history report based on said interpreted physical movement data using the external software.
124. The method of claim 123, wherein said at least one history report includes dates and times of said physical movement data.
125. The method of claim 119, further comprising:
providing additional reports and histories with respect to said interpreted physical movement data, wherein the additional reports and histories are programmed by the user via the external software.
126. The method of claim 118, wherein said physical movement data is configured to be downloaded to said computer via a wired connection.
127. The method of claim 118, wherein said movement data is configured to be downloaded to the computer via a wireless connection.
128. The method of claim 113, further comprising:
providing, via an output indicator of the portable, self-contained movement measuring device, a visual indicator to the user regarding the predetermined threshold being reached.
129. The method of claim 20, further comprising:
storing the user-defined operational parameters, the user-defined operational parameters comprising a plurality of thresholds respectively corresponding to a plurality of notifications, wherein the detecting comprises detecting occurrence of one of a plurality of user-defined events each time the movement data reaches one of the plurality of the thresholds.
130. The method of claim 129, wherein in response to detecting that one of the user-defined events occurred based on the movement data reaching one of the plurality of the thresholds, the method further comprises:
displaying, via an output indicator of the portable, self-contained movement measuring device, a corresponding one of the notifications indicating that one of the user-defined events has occurred.
131. The method of claim 129, wherein the plurality of thresholds are different from each other.
132. The method of claim 129, wherein the plurality of notifications are different visual indicators.
133. The method of claim 132, wherein at least one of the visual indicators includes a blinking indicator.
134. The method of claim 20, further comprising:
signaling, using an output indicator included in the portable, self-contained movement measuring device, the occurrence of user-defined events.
135. The method of claim 113, wherein the detecting comprises comparing said physical movement data to said predetermined threshold.
136. The method of claim 20, wherein said body part is a user's arm, and said measuring the data comprises monitoring and recording the physical movement of said user's arm.
137. The method of claim 136, wherein said measuring the data comprises measuring the data using a movement sensor of the portable, self-contained movement measuring device.
138. The method of claim 20, further comprising:

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