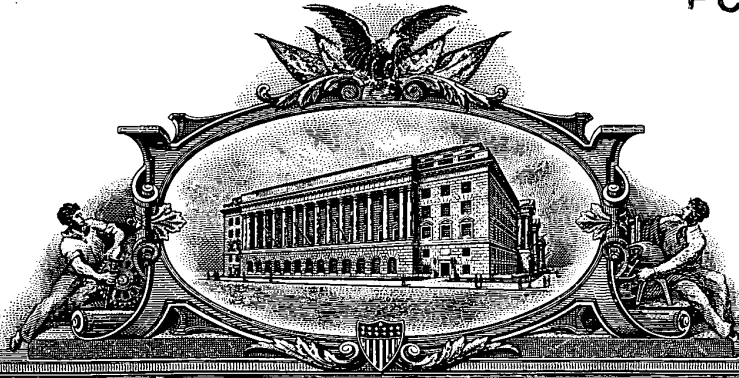


PA 1657225



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September 11, 2007

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APPLICATION THAT MET THE REQUIREMENTS TO BE GRANTED A
FILING DATE UNDER 35 USC 111.**

APPLICATION NUMBER: 60/843,422

FILING DATE: September 11, 2006

**THE COUNTRY CODE AND NUMBER OF YOUR PRIORITY
APPLICATION, TO BE USED FOR FILING ABROAD UNDER THE PARIS
CONVENTION, IS US60/843,422**

**By Authority of the
Under Secretary of Commerce for Intellectual Property
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Patent, Trademark and Copyright Causes,
Unfair Competition, Trade Secrets,
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COVER SHEET FOR FILING U.S. PROVISIONAL APPLICATION
UNDER 37 CFR 1.53(c)

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

In re Provisional Application of:
SHEMESH, et al.

Application No.: Not Yet Assigned

Filed: September 11, 2006

Title: **TRAINING SUPPORT DEVICE**
(Provisional Application)

Attorney Docket No: 27674P

Sir:

Attached hereto is the Provisional Application identified
above, consisting of 11 pages, with:

8 pages of Specification incorporating 3 Drawings into
the text, and
3 pages of claims.

The present provisional application names the following TWO
inventors:

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The Government filing fee* is calculated as follows:

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TOTAL FILING FEE* (accounting for <u>SMALL</u> entity status)	\$ 100.00

XX *Reduced by one-half, as applicants are a "small entity".
Applicant asserts eligibility for Small Entity Status.

Enclosed Application Parts:

 Application Data Sheet

XX Specification Number of Pages: 11

 Drawing(s) Number of Sheets:

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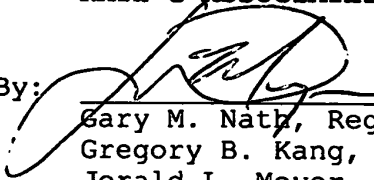
XX The invention was not made by an agency of the United States Government or under a contract with an agency of the United States Government.

XX Submitted herewith is a check in the amount of \$ 100.00.

XX The Commissioner is hereby authorized to charge any deficiency or credit any excess to Deposit Account No. 14-0112.

Respectfully submitted,
NATH & ASSOCIATES PLLC

September 11, 2006

By: 
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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Provisional Application of:

SHEMESH, et al.

Application No.: Not Yet Assigned

Filed: September 11, 2006

Title: **TRAINING SUPPORT DEVICE**
(Provisional Application)

TRANSMITTAL LETTER

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

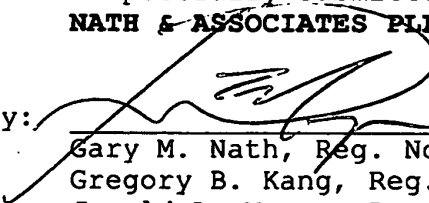
Submitted herewith for filing in the U.S. Patent and Trademark Office is the following **PROVISIONAL APPLICATION**:

- 1) Cover sheet for filing **Provisional Application**
- 2) Provisional Application, consisting of 11 pages, with:
8 pages of Specification incorporating 3 Drawings into the text, and
3 pages of Claims;
- 3) Check No.: 2824 in the Amount of \$ 100.00 for filing fee as a **Small Entity**;
- 4) Postcard for Early Notification of the Serial Number Request.

The Commissioner is hereby authorized to charge any deficiency or credit any excess to Deposit Account No. 14-0112.

Respectfully submitted,
NATH & ASSOCIATES PLLC

September 11, 2006

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- 1 -

DETAILED DESCRIPTION OF EXEMPLARY EMBODIMENTS

1. Collection of data on the location and orientation of the trainee's limbs and body in real time and throughout the entire training session.
2. Virtual trainer (which depends on the above measurements) for the trainee and advisor for the trainer

TRAINING SUPPORT DEVICE**ABSTRACT**

The present invention provides a device and method for real-time measurements of athlete movements during a training session. The device which is built of one or more sensors attached to the trainee limbs and body collects, analyzes, transmits and displays the results to the trainee and/or the coach in real-time and/or offline. This device has a particular need in the case of a training session built of repetitive tasks like lap swimming or running. In addition, the device is capable of being either a personal virtual coach that instructs the trainee in real-time and offline or an advisor for the coach that support the training session with supporting information and optional instructions.

FIELD OF INVENTION

This invention relates to training support devices needed especially in repetitive activities like swimming, running and cycling. In addition, this invention relates to virtual coaching.

BACKGROUND OF THE INVENTION

Large number of patents since the early 70s have invented devices to enable athletes the automatic lap counting and in some cases partial performance monitoring (such as strokes counting in swimming sessions) but none of them enable real-time during the lap detailed athlete limbs location and orientation data collection, analysis, displaying and coaching. These devices have used technologies such as RFID, Piezoelectric sensors, cameras, touch panels etc. none of them have used accelerometers for this purpose.

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SUMMARY OF THE INVENTION

This invention is based on measuring the athlete's movements by accelerometers (and in some cases gyroscopes are added) attached to athlete's body and limbs during a training session. The accelerometers enable the real-time location and orientation measurements of the athlete's limbs and body during the training session. The gyroscopes if added enable the real-time more accurate orientation measurements of each of the limbs (like the palm of a swimmer) and body in each and every part of the training session. The information from each of the sensors (accelerometers and gyroscopes, if any) is wirelessly sent to be collected by the coach and the trainee computerized means.

Accelerometers measure the acceleration of the limb they are attached to. The distance is calculated by double time integration of the acceleration. The following formula describes the connection between the measured acceleration and the calculated

distance: $DISTANCE = \iint ACCELERATION \, dt \, dt$ along one axis. The orientation can also be measured by the accelerometers as they may be two- or more dimensional and as such orientation can be calculated from the change in distances.

One of the leading companies in the field of accelerometers is Analog Devices Ltd. which has several devices which fit the task described in this patent. One such device is the three-axis accelerometer ADXL330 from Analog Devices that can measure up to 3g in each axis. One more device is the ADIS16006 which is a dual axis accelerometers with capabilities of measuring accelerations up to 5g.

In case we want to measure only the end of lane times of a swimmer, we will measure the marking distance from the original position of the swimmer's hand along the X axis as explained above. In case we want to measure the height to which the swimmer lifts his hand the Y axis accelerometer measurements will be used accordingly, and in case we want to measure the swimmer's hand movements in all directions, the measurements along all three axes will be used.

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Accelerometers are known for decades but, to the best of the inventor's knowledge, nobody has used them for the above or similar applications, e.g. to measure the swimmer's end of lane times and limbs or body or head location and/or orientation.

The information collected from the above sensors is stored, analyzed and
5 displayed in a box carried by the athletes (e.g. a wrist watch) and/or a bigger display
that is not being carried by the athlete and is located in places that allow the athlete to
view the results without pausing the training session. In addition, the information may
be conveyed wirelessly to a computerized device that accumulates the information from
one or more trainees. This computerized mean analyzes the information and display it to
10 the coach.

Analysis of the information (collected in former training sessions and in real-time) by a virtual coach software embedded in the athletes and coach devices, enables the athlete to receive instructions and the coach to receive advices for how to continue the training session.

15 In addition to the above, the coach will be able to send his instructions to the
trainee in real-time and without the need of the trainee to pause the training session.

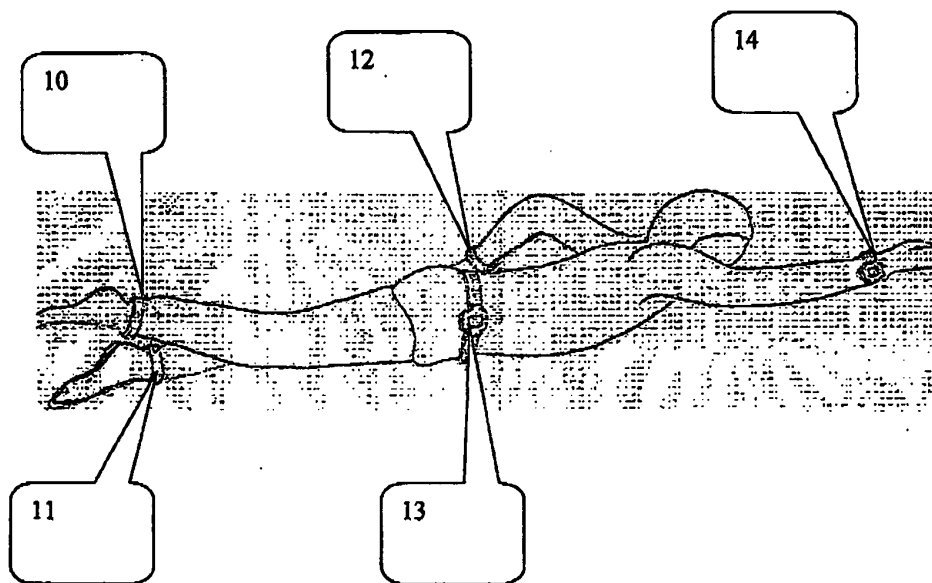
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BRIEF DESCRIPTION OF THE DRAWINGS

In order to understand the invention and to see how it may be carried out in practice, exemplary embodiment will now be described, by way of non-limiting examples only, with reference to the accompanying drawings, in which:

- 5 **Fig. 1** is a schematic placement of sensors on swimmer's limbs according to one embodiment of the invention;



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Fig. 2 is a schematic view of the communication means located at the pool side and collect the analyzed information from either the coach or the trainee and send them through a wired communication to the display submersed in the water in a way that allows the swimmer to view the information collected and analyzed and the instructions
5 from the virtual coach or the human one.

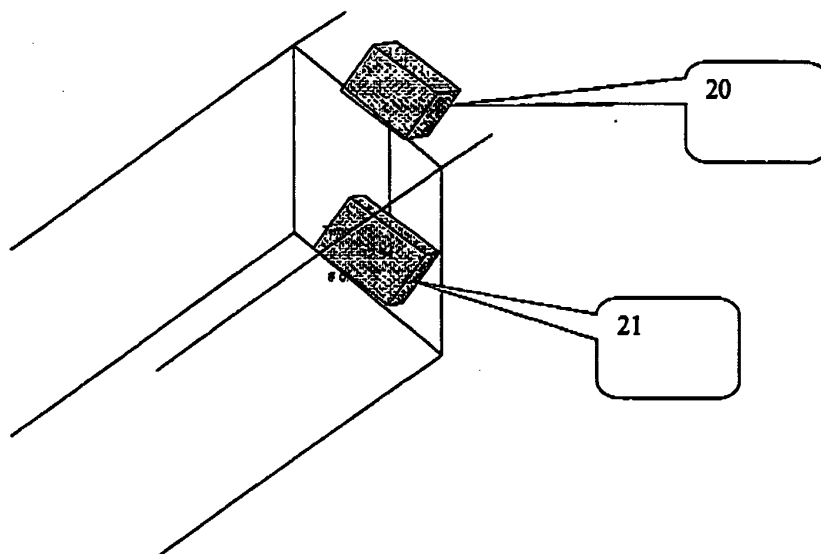


Fig. 3 is a sample screen shot of the coach computerized application in real-time. This screen shot gives an example of the data fields that a coach can choose to see
10 during a training session. The current example handles statistical measurements only of few trainees.

Name	number of completed finished laps	Elapsed time	Last lap time	Number of hand strokes per lap	Number of lag strokes per lap	Average distance per hand stroke	Heart bit rate	Average height of right hand stroke	Average height of left leg stroke
Liat	12	00:05:45	45	12	54	2.08	134	1.3	0.2
Mulan	32	00:20:45	35	14	65	1.79	142	1.2	0.15
Yaacr	11	00:06:12	54	15	88	1.67	145	1.1	0.1

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Fig. 4 is a sample screen shot of the coach computerized application in real-time. This screen shot gives an example of a specific swimmer.

Swimmer name: Liat									
Lap number	Time per lap	Number of hand strokes	Number of leg strokes	Average distance per hand stroke	Heart bit rate	Height of right hand stroke	Height of left hand stroke	Number of right leg strokes	Number of left leg strokes
1	45	12	45	1	120	2	2	45	45
2	32	13	46	2	121	2.2	2.2	46	46
3	28	14	47	3	122	1.9	1.9	47	47

5 Fig. 5 is a sample screen shot of the coach computerized application in real-time. This screen shot gives an example of the specific swimmer in a specific lap real-time data fields that a coach can choose to see during a training session. This information can be viewed in a graphical and alphanumeric way.

Swimmer: Liat, Lap number:35							
Time in the lap	Right hand height	Left hand height	Right leg height	Left leg height	Right hand orientation	Left hand orientation	body orientation
0.1	0.11	-0.14	0.05	-0.05	120	85	20
0.2	0.12	-0.15	0.06	-0.06	121	86	21
0.3	0.14	-0.16	0.07	-0.07	122	87	22

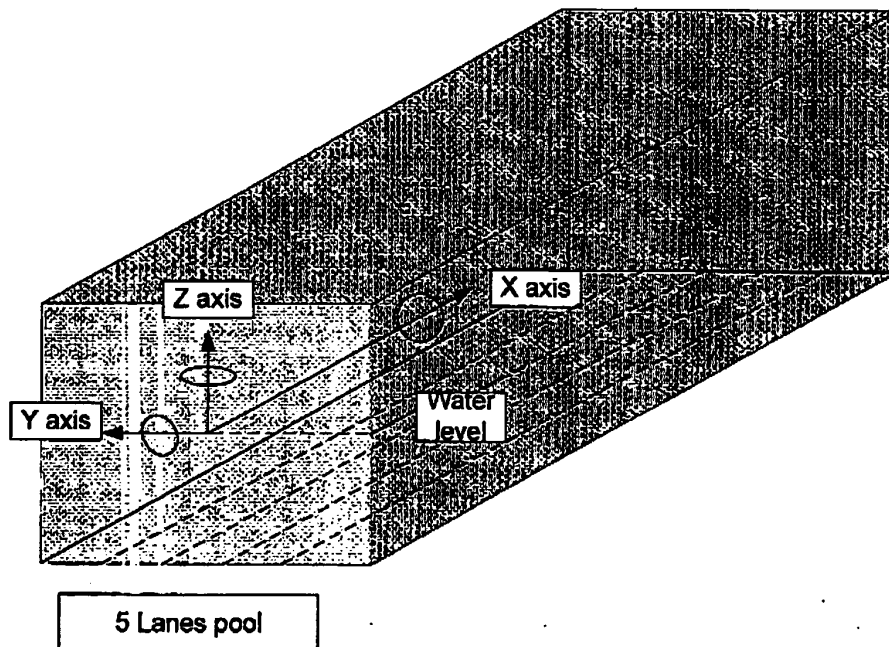
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- 10 Fig 6. is a schematic view of a 5 lanes pool. The XYZ axes are viewed with X pointing in the swimming direction, Y in the cross movement axis on the same plane with the X axis and Z which is perpendicular to X and Y defines the height (usually the origin of axes lays in the center of each lane at the water level). If gyroscopes are added, they will measure circular movements with regard to the limb
- 15 they are attached to. In case the limb is the head and the swimmer is a crawl swimmer, the gyroscope will measure the circular turns of the head which are perpendicular to the X axis.

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DETAILED DESCRIPTION OF EXEMPLARY EMBODIMENTS

A real-time measuring devices 10, 11, 12, 13, 14 for swimmer according to one embodiment of the present invention is schematically shown in Fig. 1, when mounted onto a swimmer limbs and body (in some cases head sensors are needed as well). Each device is composed of an accelerometer, optional gyro, microprocessor, memory and wireless communication means. The information collected in each of the sensors is wirelessly sent to the wrist watch 14 (which combines the sensors, microprocessor, memory, communication and display) attached to the swimmer hand and to the hand held computing mean used by the coach.

10 The information sent from the devices is collected by the swimmer watch and the coach computing means which in our case may be a pocket PC. In this embodiment a stand alone out of pool communication box 20 shown in Fig 2. received the analyzed information from either the coach or the trainee and sends it via a wired communication to an in-pool display 21 disposed in the swimmer's field of view such that he doesn't
15 need to pause and look at the watch during the swimming session.

If only one axis accelerometer is used for example the X axis (as shown in Fig 6) accelerometer, it can measure at least the following:

- End of lane time (by performing the double integration and thereby measuring the distance from the origin which is the lane start).
- 20 - Number of strokes (in each stroke we have the forward and backward movements along the X axis).
- Number of strokes can be measured if we take a one axis accelerometer in the Z axis (the swimmer's hands move up and down in each stroke).
- Movements of the hands in cross direction can be done by using measurements in the
25 Y axis.
- Orientation of the swimmer's palm can be measured by using one axis gyroscope attached to the palm. The one axis gyroscope can be used to measure the head orientation and the body orientation.

If a two-axis accelerometer is used, we can measure a combination of two of the
30 above parameters and if a three-axis accelerator is used, we can measure a combination of three of the above parameters.

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CLAIMS:

1. A device for real-time measurement of at least one parameter, different from velocity and acceleration, characterizing movement of an athlete's limb and/or body and/or head (hereinafter: "athlete's limb"), e.g. during a training session,
5 comprising at least one accelerometer adapted for the attachment to said athlete's limb for measuring the velocity or acceleration of movement of said limb along at least one axis, and a data processing unit adapted to calculate, based on said velocity or acceleration, a distance of said limb from its initial position, said at least one parameter being measured based on said distance.
- 10 2. A device according to Claim 1, wherein said at least one parameter is location of said limb relative to its initial location.
3. A device according to Claim 1, wherein said at least one parameter is orientation of said limb relative to its initial orientation.
4. A device according to Claim 1, wherein said at least one accelerometer is
15 adapted to perform said measuring at least along two mutually perpendicular axes.
5. A coaching device for an athlete including a device according to any one of Claims 1 to 5 and further including computerized means adapted to analyze readings (former and/or real-time) of the device and providing instructions to
20 the athlete based thereon.
6. An advisor for a coach including at least one device according to any one of Claims 1 to 4 and further including computerized means adapted to analyze readings (former and/or real-time) of the device and providing advices to the coach based thereon.
- 25 7. An adviser according to Claim 6, including a plurality of the devices according to Claims 1 to 4, adapted to be worn by a corresponding plurality of trainees, wherein said computerized means are adapted to analyze readings from said devices and providing advices to the coach with respect to said trainees.
8. The device of any one of Claims 1 to 4, further included one or more axis
30 gyroscopes are added.
9. The device of any one of Claims 1 to 4, where a combination of one or more axis accelerometers and one or more axis gyroscopes are used.

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10. The device of any one of Claims 1 to 4, wherein said measurements are accumulated in a box strapped to the trainee, such as, e.g. a wrist watch.
11. The device of any one of Claims 1 to 4, wherein said measurements are accumulated in a box outside the training area (outside the pool in the case of a swimmer), the accumulation being preferably performed by a computer used by the coach.
12. The device of any one of Claims 1 to 4, where said measurements are analyzed by a computerized means either on the trainee or outside the training area, the analysis including one or more of the following statistics and summary results: total training time, number of laps, average lap time, average lap velocity, average strokes per lap or per minute, average heart rate per lap, average lag strokes per lap, fastest and slowest lap, highest and lowest number of hand strokes per lap or minute, etc.
13. The device of any one of Claims 1 to 4, where said measurements are analyzed by a computerized means either on the trainee or outside the training area, said analysis including the following specific results: instantaneous speed during the laps, the time interval for sampling the velocity will be predefined, hand lifting height for each stroke, distance traveled with each hand stroke, lag lifting height for each stroke.
14. The device of any one of Claims 1 to 4, wherein said measurements are displayed on a display, e.g. an LCD, submersed in water and has a communication means to read the trainee or the coach transmission.
15. The device of any one of Claims 1 to 4, wherein said measurements are sent to be heard by an earphone with electronics that translate the trainee or coach transmission into voice.
16. The coaching device of Claim 5 or the adviser of Claim 6, wherein said said computerized means comprise a software algorithm that takes all the measurements collected in the current session and in the past and generate instructions on the athlete's behavior, like: "increase legs speed", "take a break of 30 seconds", "6 more laps to go, increase speed", etc.
17. The device of Claim 16, wherein said software based personal advisor for the coach is software algorithm that takes all the measurements collected in the current session and in the past and generate comments on the trainees'
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behavior, like: "swimmer No. 4 has lower than average lap times", "pay attention to swimmer No. 7 heart rate", "swimmer No. 3 has an asymmetric swimming in his hand strokes, left is stronger", etc.

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