

## *Influence Technique Training Data sensor (Triton Wear) To improve biomechanical variables for some stages Performance and achievement 50m freestyle youth*

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### ABSTRACT

Swimming is one of the sports with great muscular effort and complex motor performance that requires coordination and harmony between the movements of the parts of the body contributing to performance that defies the limits of humans. The development of physical abilities and the improvement of technical performance can only be separated from the support of scientific theories and technology, in order to improve training methods and feedback system based on the fusion of information and data using modern sensors and information collection system. On the performance and mechanical conditions of the swimmer to help develop performance and achievement, the researchers used for this purpose a device (Triton Wear data sensor) to collect information and feedback on performance, to prepare special exercises and correct thereal-time performance of 50 m swimmers. The research was conducted on a sample of swimmers amounting to (6) young swimmers whose technical and mechanical data was extracted after wearing the sensor under the head cover of each swimmer, and the performance data was analyzed on this system, and the experiment lasted for six weeks, during which special exercises and feedback were given. Instantaneous based on the sensor data of each member of the sample, and after conducting post-tests, it was shown that the exercises and feedback based on the sensor technology, had a direct impact on the improvement of the average performance of the sample in the 50-meter freestyle race and the improvement of all biomechanical values (such as average speed, frequency and length, acceleration and instantaneous strength) This improvement indicated that data collection and nutrition Using the sensor's multi-information fusion can be applied more precisely and differently in the training of different swimming races, and can find many motor problems in sports swimmers to describe training solutions for them, both for specific parts of the body and the body as a whole. Techniques for accurately identifying this valuable information can therefore be used for quantitative biomechanical analysis. And to reach the training process.

Keywords: Data sensor, Technology, Feedback, Head Cap, Physical abilities, technical performance, Triton Wear.

### المستخلص

التدريب بتقنية مستشعر البيانات (Triton Wear) لتحسين المتغيرات البايوميكانيكية لبعض مراحل الأداء وإنجاز

### سباحة 50 م حرة شباب

تعد رياضة السباحة من الرياضات ذات الجهد العضلي الكبير والأداء الحركي المعقد الذي يتطلب تناسقاً وتوافقاً بين حركات أجزاء الجسم المساهمة بالأداء الذي يتحدى فيها حدود البشر. ولا يمكن الفصل بين تنمية القدرات البدنية وتحسن الأداء الفني إلا بدعم من النظريات العلمية والتكنولوجيا، لأجل تحسين أساليب التدريب ونظام التغذية الراجعة على أساس اندماج المعلومات والبيانات باستخدام أجهزة الاستشعار الحديثة ونظام جمع المعلومات عن الأداء والشروط الميكانيكية للسباح للمساعدة في تطوير الأداء والإنجاز، وقد استخدم الباحثان لهذا الغرض جهاز (مستشعر البيانات Triton Wear) لجمع المعلومات والتغذية الراجعة عن الأداء، لإعداد التدريبات الخاصة وتصحيح الأداء الآني لسباحي 50 م سباحة. وقد اجري البحث على عينة من السباحين بلغت (6) سباحين شباب تم استخراج البيانات الفنية والميكانيكية الخاصة بهم بعد ارتداء المستشعر تحت غطاء رأس كل سباح، وتحليل البيانات الخاصة بالأداء على هذا النظام، واستمرت التجربة لمدة ستة أسابيع تم خلالها إعطاء التدريبات الخاصة والتغذية الراجعة الفورية على أساس بيانات المستشعر لكل فرد من أفراد العينة، وبعد إجراء الاختبارات البعدية ظهر أن التدريبات والتغذية الراجعة المعتمدة على وفق تقنية المستشعر، قد أثرت بشكل مباشر على تحسين متوسط أداء العينة في سباق 50 متراً سباحة حرة وتحسين جميع القيم البايوميكانيكية (كمعدل السرعة وتردد الضربات وطولها والتعجيل والقوة اللحظية) كان هذا التحسن يشير الى أن جمع البيانات والتغذية الراجعة باستخدام اندماج المعلومات المتعدد لجهاز الاستشعار يمكن تطبيقه بشكل أكثر دقة وبشكل متميز في تدريب سباقات السباحة المختلفة، ويمكنه العثور على مشاكل حركية عديده عند السباحين الرياضيين لوصف الحلول التدريبية لهم، سواء بالنسبة لأجزاء معينة من الجسم أو الجسم ككل. وبالتالي يمكن استخدام تقنيات تحديد هذه المعلومات القيمة بدقة لتحليل البايوميكانيكي الكمي وبلوغ عملية التدريبية.

الكلمات المفتاحية: مستشعر بيانات، تقنية، تغذية راجعة، غطاء الرأس، قدرات بدنية، أداء فني، جهاز Triton Wear.

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## Introduction

Swimming is one of the sports that require special physical abilities and kinetic compatibility consistent with the requirements of the aquatic environment, which imposes on the swimmer various resistances according to the nature of the performance, the required movements, and the position of the body while swimming. Until nearly ten years ago, the majority of coaches emphasized that the swimmer should look ahead when freestyle, while giving feedback to the The body on the surface of the water, however, does not necessarily address the horizontal position (as far as possible) during swimming to reduce water resistance during progress (swimming), especially in the 50-meter freestyle. Good body posture in the water is especially important in swimming because moving through the water efficiently does not come naturally to the swimmer.

The basic stability in the swimmer's performance refers to the ability of the trunk muscles to keep the spine and hip girdle functioning as a single unit during movement. This means that the limbs can then work with increased efficiency because they are not trying to help stabilize the movement. (Huang, Chen, & Pan, 2020, p. 7001).

Biomechanics plays an important role in giving positive results by improving and developing technical performance (technique) (Muhsen & Abbas, 2022, p. 240).

Most swimmers have much stronger and more capable trunk muscles, however, many are not used to using them or feeling their benefits. Essentials to swimmer's performance is that the hips and shoulders rotate side by side around the longitudinal axis partially and alternately as you progress, which must work as a unit all the time for optimal power generation and body positioning. Scientific evidence for some research suggests that slower or weaker swimmers tend not to use the hips much or not at all, and instead tend to rely solely on shoulder strength all the time. (Hellard, Scordia, Avalos, Mujika, & Pyne, 2017).

The swimmer's performance is usually monitored from the moment of starting until he reaches the first 15 meters to determine the first speed and acceleration. Then follow the performance for varying distances of the race distance and finally follow the performance in the last few meters (usually the last 5 meters) i.e. Before touching the wall at the end of the race. This requires assistive technology to measure temporal, kinetic and spatial variables. To be reviewed and take advantage of the rapid data resulting from it to help the swimmer perform correctly and create the required tension in the muscles of his body, which allows him to control the movements of the arms and legs and the mechanism of breathing correctly, and allows the major back muscles such as the latissimus dorsal muscle to provide strength instead of relying on relatively small deltoid muscles in the shoulder. This is something that is missing for many swimmers of different age groups, especially young people, and juniors. Instead, they focused on pulling themselves through the water ineffectively from the shoulder. (Yuan, Yang, & Liu, 2021, p. 3915).

The sport of swimming has recently witnessed a great development in the level (Saleh & Ali, 2022, p. 318).

The technique of detecting technical and mechanical information associated with performance is a relatively sophisticated technology. In today's information age, the appropriate choice of sensors and the advantages of complementary sensors is one of the most important devices to obtain immediate information and benefit from it in the preparation of exercises and give feedback in order to improve the swimmer's ability, technical performance and efficiency, and from this point of view the researchers used (data sensor device Triton Wear) to help obtain technical and mechanical data and make the required corrections and exercises with the aim of improving performance and developing achievement for young 50m freestyle swimmers.

Collecting movement and feedback information refers to the use of certain means to track and capture the movement of the human body, obtain certain substances and analyze and process these and matter substances, in order to draw the data and conclusions required to improve the level of exercise (Zong, Ji, Yu, & Shi, 2020, p. 1163).

Many scientists at home and abroad have used relevant research. (Yang, Qie, Li, Shi, & Pan, 2016, p. 5934) They used the optical photometric method to collect human body motion information, including high-speed photography, video recording, photoelectric detection, and electrometry, which mainly uses sensors or sensor elements that are installed in the human body that convert the mechanical movement of the human body into electricity and perform quantitative measurement; as well as the photoelectric signal measurement method (Mosalanejad & Arefi, 2018, p. 759).

Recent research has shown that any behavioral process of the human body will produce a corresponding bioelectrical signal, and this method is to use an electrode installed on the surface of the human body to collect the EMG signal for mathematical behavior analysis (Mooney, et al., 2015, p. 1001).

Some studies have suggested that multisensor information fusion is a human-simulated process. Sensors are like human sensory organs, which obtain the required information about performance. This is the multi-sensor principle of information fusion. (Lo & Kuo, 2017, p. 448).

Some devices that can be used for strength and muscular endurance training have recently appeared, and these devices have become safer (Kalaf, 2018, p. 372).

Dynamic obstacle detection is believed to be a multi-sensor information fusion technology to detect dynamic obstacles in autonomous motion. (Liu & Maglishaw, 2003, p. 34).

One of the foundations for the success of functional strength training is to maintain the motor performance as much as possible (Mohammad & Alshamaa, 2021, p. 9).

Smith et al. argued that the impact of the e-learning system using the feedback system is that the e-learning system is a blended learning environment for ICT education. This research was designed at a Japanese university as an e-learning system to collect information and feedback on student performance. The results of the application were effective and effective, but they lack a large amount of empirical data. (Smith, Norris, & Hogg, 2002, p. 543)

This research aims to identify the effect of training with sensor data (Triton Wear) and give feedback in some biomechanical variables of the stages of performance of 50 meters freestyle youth, and to find a scientific and effective training method for swimmers through the design of a system for collecting information and feedback. The fusion of multi-sensor information and feedback mode and its applicability to 50-meter freestyle swimmers Youth, which is of great importance in improving the mechanics of swimmers' performance and achievements. The researchers assumed that the training with the data of sensors device (Triton Wear) and feedback, the existence of statistically significant differences between the pre- and post-tests of some biomechanical variables and the achievement of the members of the research sample.

## Materials and Methods

The purpose of this section is to show what has been done, how, and where, in a direct and simple way as well as to define how data has been collected, displayed, and analyzed. This section should take into consideration the chronological order of the manuscript procedures and mention to the important details only. The research sample was selected deliberately amounted to (6) swimmers of the 50 m freestyle competition from the swimmers

of the specialized swimming school of the Ministry of Youth. They were under 20 years of age according to FINA rules and the morphological measurements of the sample were as shown in Table (1) below:

Table (1) Homogeneity of the sample members

Physical measurements	Mean	standard deviation	Mediator	skewness
length	1.77	0.03	1.75	2
Body mass	65	3.5	66	0.86
Training Age	7.5	1.6	7	0.93

The researchers used sources and references, electronic information network, observation and experimentation, personal interviews, tests and measurements, a measurement of height and weight, a stopwatch, cones, a scale of (1) meter, and a smart sensor (Triton Wear).

The pre-test was carried out on (3/12/2022) that included swimming for a distance of 50 meters (legal), and the sensor device was placed under the head cover of each swimmer (behind the head) in order to extract the biomechanical variables under research for the starting stage and accelerating a distance of 15 m, a distance of 30 meters, and the last five meters of the race, as the distance of 50 m swimming was divided into specific sectors to facilitate data monitoring and training, as the first distance (from the beginning to the mark was a distance of 15 meters) . And the second distance (from the end of 15 meters to the end of the first 30 meters, then the last 5 meters before the end of the race before the wall), and the swimmers were emphasized by describing their strokes during these stages, the average speed, the mechanical position of the trunk and legs, and the mechanics of breathing as feedback, as well as training with resistances outside and inside the water to enhance the physical abilities related to performance correction and biomechanical variables for the swimmer's performance, which the researchers believe need To improve and develop by special exercises and according to sensor information.

Sensing technology has facilitated the analysis of performance mechanics and evaluation of exercise intensity and thus enabled training more efficiently. It will fill gaps around additional information that helps practitioners to select systems and methods for extracting key performance-related instruments that are important for them to analyze swimmers' performance and can be useful in enriching both applied and research practices.

The number of training units was (24) training units and a period of two months (8) weeks and three units per week, the training was applied from (9/12/2022) until (21/1/2023), and the exercises were in the main section of the training unit as corrective information as well as some physical exercises that are related to the modification of the A technical performance based on scientific foundations. After completing the training, the researchers conducted the post-test on (25/1/2023) with the same conditions and specifications as the pre-test.

## Results

Table (2) arithmetic means, standard deviations, differences and their deviations, calculated T value, significance level, and the difference function for the pre- and post-tests of the biomechanical variables of the research sample.

Variables	mean		Standard deviation		MD	SD.MD	T	SIG
	Pre	Post	Pre	Post				
Time 15 m (s)	8.868	7.960	0.18	0.136	0.908	0.310	2.924	0.015
Time 30 m (s)	17.73	15.92	1.02	0.980	1.815	0.595	3.051	0.003
Last 5 m time (W)	2.956	2.653	0.36	0.24	03.03	0.101	2.998	0.034
Achievement 50 m (s)	29.56	26.53	0.20	0.178	3.025	0.876	3.453	0.006
Total start time	0.78	0.71	0.08	0.07	0.07	0.031	2.217	0.358
15 m S. rate	1.16	1.21	0.30	0.25	1.05	0.352	2.980	0.025
30 m S. rate	1.18	1.25	0.40	0.27	0.07	0.023	3.017	0.003
5 m S. rate	1.25	1.27	0.15	0.10	0.02	0.013	1.500	0.357
Strike length 50 m	1.28	1.34	0.39	0.025	0.071	0.006	10.95	0.000
Strike frequency 50m	1.16	1.23	0.24	0.18	0.07	0.022	3.10	0.032
V. 50 (M/s)	1.73	1.79	0.98	0.84	0.06	0.021	2.851	0.046

at the significance level of 0.05, and the degree of freedom is 5.

## Discussion

The statistical results presented in Table 2 above showed that the results of the data extracted through the sensor helped the swimmer to correct movements in the arms by emphasizing the use of his core muscles to lift the body in the water, allowing larger back muscles such as the latissimus dorsi muscle to provide strength instead of relying on the relatively small deltoid muscles in the shoulder. This is enhanced to achieve the best mechanical situation that helps to reduce the time of covering distances in general, and this is what the researchers did, which enhanced the performance of the members of the research sample (swimmers), which made them focus on pulling themselves through the water in an ineffective way from the shoulder, and thus an improvement appeared in the number of blows for different parts of the distance, and this matter contributes effectively to improving the speed of the swimmer because the rate of strikes is included in measuring the speed of the swimmer.

This is indicated by various studies, as some scientists (Ohgi, Ichikawa, Homma, & Miyaji) applied an inertial sensor cannula to determine the stages of propulsion after swimming progress through the accelerometer device worn by the swimmer on the wrist, and



it appeared through analysis that the swimmer's strokes during acceleration were consistent with angular velocity measurements (Ohgi, Ichikawa, Homma, & Miyaji , 2003, p. 118).

The feedback that the sample members were exposed to force the swimmer to change the angles in the arms in order to achieve a good angular movement that ends with a quick movement of the palm (circumferential speed) in (shoulder, elbow and wrist joint) continuously, along with controlling the movements of the rest of the body, to change the position of the hand in the water and generate the required thrust. It was easy to track these movements by analyzing signal prevention from sensors. The results of the research confirmed that sensor data could be used as a new way to analyze the performance and mechanical conditions of swimmers.

In addition, this work highlighted the nature of the individuality of the signal for each stage of performance, as the absence of differences between the pre- and post-times of the performance stages of the research sample convergence of performance to the sample as a result of the feedback given to them, which made them achieve greater acceleration and control of the stages of arm work more accurately during the forward crawl (James , et al., 2012, p. 145).

These biomechanical variables were determined by sensor data, where acceleration data was used as a secondary confirmation of arm movement from the moment the hand entered the water, and this feature was not previously determined with high accuracy by conventional analysis improved for arm strokes for 50-meter freestyle stages for youth.

Previous research has found a strong linear relationship between sensor-derived data and standard data defined from video footage.

The researchers exploited these characteristics of the muscles responsible for that performance through feedback at times and giving the necessary exercises to develop the working muscles at other times.

However, this research showed for the first time that the signal for the start of acceleration using the sensor used can be determined, as well as biomechanical changes for all stages under study, as it is established that the pattern of movement of the hand while swimming shows significant differences due to various factors including anthropometric and individual technical differences, level of technical performance, swimming speed and fatigue. (Seifert, Leblanc, Herault, & Kumar, 2011, p. 555)

Swimming distance is a more important functional consideration for sensor-based systems designed for swimmers, who do not benefit from a trainer to monitor their training. In fact, in addition to wanting to know any other information about performance.

The speed of swimming is a key indicator of good performance, as the results indicated the improvement of this mechanical variable for the members of the research sample, and by comparing the extraction of this variable with the sensor with the usual methods, it was shown that obtaining the data on this variable and giving it as feedback was easy to measure this variable by hand. (Dadashi, Millet, & Kamiar, 2015, p. 40) However, this variable was improved by using the technical method of sensor-mediated performance monitoring, which was reflected in the improved speed achieved during the race distance. This does not indicate that this approach used by the researchers provided a sound way to measure speed as a key variable as well as using this variable in training to improve it for the sample members. Which is necessary for accurate measurements.

As for counting the swimmers' strike rate, this was difficult to determine in studies that dealt with this even with underwater video, as the movements are fast and water turbulence can obscure vision and follow-up. Thus, the sensor used in the research helped to accurately determine the swimmers' strokes and gave high practical reliability during the different stages of the race, and the results indicated a significant improvement in the post-test as a result of careful observation and correction given to the sample members. SD One study

that evaluated the inclusion of inertial sensing technology as part of a common and integrated performance monitoring system for use in elite swimming aimed at significant progress in freestyle stroke patterns (Fulton, Pyne, & Burkett, 2009, p. 1053).

The sensor helped the user to obtain the data, from the identification of different stages, which allowed the extraction of key information related to performance and the determination of the distance and time of performance when the start stage is completed (defined as the mark of 15 meters), in addition to that it was dealt with in isolation to determine the entry point at the end of the flight phase, based on the evidence provided, which helped to give the appropriate correction to the sample members, which contributes to improving the performance time of this stage.

## Conclusions

One of the researchers' conclusions is that the use of the sensor helped identify many aspects of swimming analysis that are unexplored, but vital from a training point of view. This achieved accuracy in measuring the biomechanical variables that can be measured, both in the analysis of the beginning and the different stages, which helped in giving feedback and in preparing the necessary exercises to bring about a state of improvement in the performance of the sample members, which was achieved by positive development in partial times and in the rate of strokes of swimmers. In the final achievement, this will open a new path for many coaches. The researchers recommended that future work should also focus on applied studies to demonstrate how this technology can be used to influence training practice.

The results indicate that the sensor technology used by the researchers had tremendous potential to influence performance correction according to biomechanical information and identify key performance variables such as acceleration, speed, number of strokes, stroke length and frequency, and that this technology had the ability to provide the required accuracy and speed of feedback. Researchers should continue to strive to provide an adequate evidentiary basis for the advantages of rapid analytical sensors. To benefit from it in helping trainers without relying on methods Traditional to analyze swimming performance and provide feedback.

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