Modern Light Sport Training Systems:
Critical Analysis of Their Construction and Performance Features

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Abstract: Modern digital technologies help to provide the athlete progress in the majority of sport kinds. There are too many sport gadgets intended for different training aims. So, assessment of their advantages or disadvantages is difficult for a coach or other customers. The aim of our research was to provide a detailed comparison of the light sport training systems available with the identification of the operation features. Methods. FitLight™, BlazePod and XLiGHT sport training systems were considered in terms of usability, features, performance and diagnostic possibilities. It has been found that FitLight™ is more suitable for sport diagnostics. It should be mentioned however that BlazePod and XLiGHT simulator are more affordable and can be high in demand by coaches.

1 INTRODUCTION

The modern training process is unthinkable without the use of multimedia support for sports. Over the past ten years the qualitative approach to the organization of sports training has fundamentally changed in amateur and professional sport as well as in sports reserves training in sports clubs and schools.

Thanks to the universal digitalization nowadays plenty of devices of fixing and analyzing the training process parameters are used everywhere. There are heart rate monitors with GPS-navigation for endurance athletes, force platforms and photo finish (timing systems) for sprinters, video recording with subsequent analysis of sport technique of exercises performance, etc. Thus power, endurance and speed are under super vision of information technologies.

Until recently coordination development was far away from using support digital technologies. Taking into account that it is coordination training that requires novelty and unpredictability easily provided by gadgets, the appearance of light sports systems was predictable. Now such means of sport multimedia support as the visual coordination simulators or light sport systems are gaining popularity in team and martial arts sports.

Light Sport Training System is a complex of wireless lights coming on randomly or in a given order by the control device and deactivated by user's touching them as fast as possible. It is designed mainly for training of quick reaction and coordination development in various sports. At the same time, changing the Light Sport Training System settings and exercise conditions allows you to design a training session of any orientation. In addition, the presence of a timing system and statistical processing of the response speed allows you to objectively control the level of development of coordination abilities.

The first and thus named revolutionary light sport system FitLight™ Trainer was officially introduced in 2011 (FitLight manual, 2021). This simulator (Figure 1) was invented by Canadian specialists and assembled in China.

In March 2017 the Israeli company BlazePod (BlazePod presentation, 2017) announced their brand innovative system (Figure 2).

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The Russian company "Shaiber" introduced its XLiGHT simulator (figure 3) in 2019. In fact, it is an adaptation and localization ("whitelable") of Reaction Training Lamp (China).

Due to their availability and simplicity of operation light simulators are confidently gaining the market of sports training support products.

However, manuals of these Light Sport Training Systems present directions for usage but do not contain technical peculiar properties.

The aim of our research was to provide a detailed comparison of the light sport training systems available on the market with the identification of the operation features.

2 METHODS

To provide the critical analysis of light sport systems three main aspects were selected: size and price, connection and operation features.

2.1 Size and Price

This section includes an analysis of the external parameters of the device:
- Description of the delivery set, available configurations and dimensions (physical data);
- Prices;
- Ergonomics of the product as a whole and the sensors separately;
- Charging features;
- Accessories.

2.2 Connection Features

The analysis of the connection features of light sport systems includes an analysis of the external parameters of the device:
- Common features;
- Control devices;
- Limitations of the Bluetooth™ protocol;
- Software features, localization;
- Functional capabilities of sensor (signal-response);
- Data upload, storage and synchronization.

2.3 Operation Features

Following details were under consideration in this department:
- Using in training;
- Using for testing.

3 DISCUSSION

For the critical comparison of sport devices for coordination development following light sport systems were available: FitligtTrainer™ (FitLight Sports Corp., Canada), Blazepod (Israel, Tailand) and XLiGHT (Russia). All rights reserved.

3.1 Size and Price

3.1.1 Description of the Delivery Set, Available Configurations and Overall Dimensions

The FitLight Trainer™ is designed to be used as a training aid for athletic conditioning. Official delivery is possible in the following versions: 4, 8 and 24 sensors.

Figure 1: FitLight Trainer™ in case.

Blazepod are available in three standart options: 4, 6, and 8 sensors.

Figure 2: Blazepod 6 sensors version.

XLiGHT is available in a set of 6 and 8 sensors.

Similar sets of light sport systems with a minimum and sufficient set of sensors (6-8 pcs.) with the necessary equipment included in the delivery package were selected for comparison (Table 1).

Figure 3: XLiGHT exterior of the opened set.

Table 1: Physical parameters and the content of sport systems sets.

Device	FitLight Trainer™	Blazepod	XLiGHT
Set weight, kg	6,92	1,13	1,75
Case	Carrying + charging case	Cylindrical case with zipper	
Case size	500x400x200	250x100x100	320x110x110
Control device	Tablet PC included	Any android or iOS device (not included)	
Charging devices	1 tablet+ 1 for sensors	Doc-station + USB cable	USB- cable

3.1.2 Prices

The prices of Light Sport Systems (Table 2) are official and were obtained via a request of distributors in Russia in 2021.

Table 2: The price of 6-8 sensors version.

Device	Price, USD
FitLight	5367
Blazepod	522
XLiGHT	349

3.1.3 Ergonomics of the Product

Each of the presented light sport training devices has a hard case or a box with a carrying handle.

The FitLight™ sensors have a cosmic disk shape, each located in an individual cell made of foamed polyethylene, which also serves as a charging port.

The Blazepod sensors are cone-shaped, arranged in a trunk one behind the other, slightly recessed one into the other.

XLiGHT sensors have a 6-angle shape, located in the case one after the other.

All presented sensors are moisture and dust protected, thus allowing the usage of gadgets in open air, even in conditions of high humidity, including rain and snow (Table 3).

Table 3: Physical parameters of sensors.

Device	FitLight Trainer™	Blazepod	XLiGHT
Sensor weight, kg	0,252	0,130	0,150
Sensor lenght, mm	125	100	95
Sensor width, mm	125	100	85
Sensor height, mm	45	42	20
Sensor water resistance class	IP65	IP65	IP65

3.1.4 Charging Features

Each of the simulators under consideration has an individual battery in its sensors with the possibility of recharging.

FitLight sensors equipped with NiMH 850 mAh battery The battery is replaceable, additional batteries are not included in the delivery package. Charging is carried out only with a standard 110-240 V ac charger, which is a carrying case. Charging is possible only in the opened case. To charge the battery the sensor is placed in the individual cell (socket) in the correct position. The full charging time is 4 hours. The sensors are always on (standby mode) and ready to connect to the control device.

Our research focused on operation time of FitLight batteries has revealed that full charge provided 6 hours of continuous operation while the ability to work in standby mode was 72 hours without recharging.

The Blazepod is a not replaceable 600 mAh Li-pol – battery. Charging is carried out via the charging station included in the kit via the microUSB cable, also included in the kit.

The sensors are positioned one above the other, stable due to the cone shape. Charging is performed with a standard USB port (110-240V ac adapter, PowerBank, USB PC socket).

It is available to charge this device from a single charging station using a single power source up to 8 sensors simultaneously. The full charge time is 2 hours. The sensors are always on, in standby mode, and ready to be connected to the control device.

So the BlazePod battery provides 8 hours of operation and it can work in standby mode for 200 hours without recharging.

XLiGHT has 600 mAh LiPol-ion battery,which is not replaceable as in BlazePod. Charging is carried out through an individual connection of the sensor via a microUSB cable to a power source (110-240V ac adapter, PowerBank, USB PC socket). It comes with two microUSB cables with 4 charging ports each. So to charge 6 or more sensors simultaneously, you need two power sources with USB ports. The full charge time is 2 hours. The sensors are equipped with an automatic shutdown system in case of prolonged absence of communication with the control device. Self-shutdown of the sensor takes place after 15 seconds of inactivity. Switching on is done manually, which significantly saves battery power during standby mode. The measured time of work in the standby mode was 500 hours without recharging (our experimental data).

So, FitLight is the least mobile and requires 110-220 ac. The FitLight sensors have the fastest self-discharge time since they are always in the switched-on state. The Blazepod operate without recharging for several days. For long-term field work the presence of a powerbank is required. XLight has the longest self-discharge time.

3.1.5 Accessories

It should be mentioned that the availability and accessibility of accessories is a very important factor influencing the possibility of using the analyzed sport simulators. The purpose of the additional elements is to organize the mounting of the sensor on various surfaces.

Since the FitLight Trainer was first introduced to the market, and has long been used in various sports and training conditions, it has a large arsenal of optional accessories (Figure 4).

Figure 4: FitLight trainer accessories.

There is a number of accessories available for different training conditions: protective cones for working with feet on horizontal surfaces, magnetic holders - for working on metal surfaces; frames for use in open spaces: protective covers for using sensors as targets in football or tennis, etc. The list of available accessories is constantly growing and expanding thanks to the efforts of the manufacturer. The drawback is the rather high cost of accessories.

The accessories kit includes a Velcro fastening system and self-adhesive plates both allow you to organize a fastening to any surface. The disadvantage of this method is the unreliability of the jointly formed contact patch since the support element is attached to the sensor with a latch. During intense training or testing, when the athlete deactivates the sensor not by hitting the center precisely but on spherical edge when the sensor is located on a vertical wall, an excessive load on the latch leads to a breakdown of the mounting system. With a very reliable and durable lamp, the fasteners (latchers) are the weakest place in FitLight system. In addition, it is not amenable to self-repair.

The Blazepod trainer does not have any additional attachments to the surfaces. Only horizontal use is implied. The sensor has a coating of contact surface that prevents excessive slipping, which makes it comfortable to use on any surfaces (lawn, asphalt or parquet). To expand the training capabilities, the following accessories are available (Figure 5).

Figure 5: Blazepod accessories.

The kit includes universal mount for fixing the sensor and suction cups for smooth vertical surfaces (mirror, glass). There are belts for attaching the sensor to items such as a punching bag, pole, etc. The option of mounting on a training cone is also available. All above mentioned expands the range of use of the Blazepod simulator.

The XLiGHT sensors already have a built-in magnetic mount, allowing them to be placed on metal surfaces in any planes without the use of additional elements. The installed magnet is powerful enough that the sensor can be fixed even horizontally above the athlete without fear of the sensor falling. In addition, self-adhesive magnetic platforms for placement on all surfaces and powerful magnets with Velcro are included. Reflective pads are available for purchase to work with the sensor with such elements

as a club or a racket. The metal platforms for mounting on a cone or for vertical positioning of the sensor on a horizontal surface, straps for mounting on vertical elements (punching bag, pole) are also available to buy separately. Possible options are shown in Figure 6.

Figure 6: XLiGHT accessories.

Each of the considered simulators has in its arsenal a set of mounts available for purchase, which allows to significantly expand the scope of this simulator and significantly diversify the training process.

3.2 Connection Features

3.2.1 Common Features

Each of the three described simulators has the ability to connect to a control device, which is responsible for the execution of the "request-response" command by the sensor with fixing the time of its execution. Each simulator has original software made exclusively for this type of sensors.

All visual coordination simulators are controlled with mobile applications. Applications are original software products adapted to a unique type of sensor. The sensors of all simulators have an individual code and connection algorithm and work exclusively with their own application. In this case, it is possible to connect an additionally purchased sensor of any of the above systems to an application corresponding to this sensor. Thus, it is possible to replace the failed sensor individually, avoiding replacing the entire set.

3.2.2 Control Devices

FitLight is a tablet PC running Android OS with pre-installed original software and an original Bluetooth communication module with an extension of up to 24 connected devices. This control device is included in the delivery package and is the only possible way to control the sensors. The control device is also equipped with an individual charger, which requires an additional connection to the 110-240 V ac.

The control device of Blazepod is a smartphone with the Android and Ios operating system. It is necessary to have a module in the smartphone that connects via the Bluetooth protocol. Various smartphone manufacturers set the maximum number of Bluetooth-enabled devices, usually from 3-12. Each sensor is an independent Bluetooth device. This must be taken into account when choosing a smartphone to work with the simulator. The control device is not included in the package. It is assumed to use a personal device, or purchased additionally for these purposes.

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3.2.3 Limitations of the Bluetooth Protocol

The Bluetooth™ protocol imposes certain restrictions on the use of devices, while the FitLight simulator uses a hardware amplifier signal, which allows you to expand the work distance of the device up to 100 m.

The Blazepod simulators use an amplified signal from the sensor, which allows you to work with the control device up to 70 meters distance.

Xlight uses the Bluetooth receiver of the device (smartphone) which limits the range to 30-40 meters

Blazepod and XLiGHT use Bluetooth receiver of the device (smartphone) which limits the range to 30-40 meters.

Using simulators as testing tools, it is necessary to take into account the position of the control device relatively to the sensors, because any movement of the control device, as well as the occurrence of

obstacles in the path of the signal passage, affects the result of the "signal – response" feedback.

3.2.4 Software Features, Localization

Fitlight and Blazepod are controlled by an app with an interface in English, no localization is provided. XLiGHT is controlled by the application in Russian with the ability to change the control language to English (pre-installed in the application). Each of the applications has several preset options for different workouts, and the number of them varies:

FitLight: there are 12 preset options, divided by sport, with an ability to customize the parameters (sensor distance, sensitivity, color and mode, time delay, timeout, etc) in each option;

BlazePod has more than 100 preset options, broken down by the training focus. There is no ability to change any option, but users can create their own training program based on preset exercises with the ability to save them as new. Each of the options presented has a detailed scheme and visualization of the performance in the form of photos and video content;

XLiGHT suggests 19 preset original exercises without reference to a specific sport and type of training. There is an ability to create an individual exercise as a separate mode.

Localization: Fitlight and Blazepod are controlled by an application that has an interface in English, localization is not provided. XLiGHT is controlled by the application in Russian with the ability to change the language to English (pre-installed in the application).

3.2.5 Functional Capabilities of Sensor (Signal-Response)

Each of compared sensors have their peculiarities (Table 4).

3.2.6 Data Upload, Storage, Synchronization

The software of each simulator has an algorithm for forming and storing a database of the training process.

Each of the presented simulators has the ability to create an individual profile, link it to a sport, store training and testing data, and send it by email. csv format. The amount of information stored is limited by the memory of the device that is used to control the sensors.

3.3 Operation Features

3.3.1 Using in Training

Each of the presented simulators has a number of functions for implementation in the process of sports training. Interaction with the sensors is carried out through a visual analyzer and a sequence of actions determined by a specific exercise. Thus, the task of coordinating motor actions is performed in accordance with the specified parameters: flash time, flash duration, touch time (interrupting the photocell). This allows you to objectively assess the speed and correctness of the exercise during sports training.

3.3.2 Using for Testing

To determine comparables of data obtained from three Light sport systems in testing following experiment was carried on. Group of athletes (n=50) 11 years old were tested for "Hand-Eye coordination" in the same conditions (light placement and testing time) using all simulators. The following average data were achieved: Fitlight 439,73±55,42 ms; XLiGHT – 497,71±62,24 ms; Blazepod – 564,60±55,03 ms.

The main limitation of using Blazepod and XLiGHT simulators as testing tools is their instability in response time to interaction. Blazepod simulator has no photosensor. That is why it is impossible to measure reaction time reliably. To trigger the sensor, a touch with some force is required, which is not described in the manual and cannot be measured.

At the same time using one simulator allows to test a group of athletes without comparison with other groups tested by another simulators (Chepanov, 2021).

At the time of writing, the XLiGHT simulator is not widely distributed, which does not allow using it as a reliable source of information for testing.

Table 4: Functional capabilities of sensors in sport training systems.

	LED indication: full	LED indication: centre only	Touch sensor	Impact sensor	Close range photo sensor	Long range photo sensor
FitLight	+	+	+	-	+	+
Blazepod	+	-	+	-	-	-
XLiGHT	+	-	+	+	+	+

The main reason is the lack of a description of the delay time of the response of the photo sensor and the touch sensor. These simulators are also used with various devices (smartphones, tablet computers), which is a limitation on the reproducibility of test results due to the difference in the speed of information exchange between the control device and the sensor installed by the manufacturer of smartphones and tablet computers and different not only within the manufacturers, but also device models. Due to its rather long presence on the market (10 years), the FitLight simulator is widely used in organizations engaged in sports training (Rogozhnikov, 2020). At the same time, the components used have a standard response time (90 ms).

The control device also has the same characteristics, regardless of the set and the prescription of delivery. All of the above allows you to use the FitLight simulator as a testing tool with high reproducibility of the result (Shvab, 2020), (Zakharova, 2019).

4 CONCLUSIONS

Three light sport gadgets−Fitlight™, Blazepod and XLiGHT have been the subject of discussion. Their physical data and software, operation features and energy supplement were considered to determine cons and pros as well as to define the convenience and validity of using the applications in training and testing. All devices under consideration are excellent instruments for organizing the innovative coordination and agility training.

Fitlight™ trainer can be considered the most optimal tool for the athletes testing as it provides the more reliable response time due to the fact that control device is included. In other devices signal processing algorithm based on the "receive-transmission" principle completely depends on Bluetooth controller smartphone.

Blazepod is easy to connect and does not require special skills in mastering the software. Each exercise in software is provided with detailed instructions and video demonstration. It is not recommended to use it as a test tool because of the large difference in response time on different control devices. XLiGHT is the youngest among the presented systems and has gained the best features of sport training systems previously released by competitors. But it is still "half-made", thus it needs improvement both in hardware and software.

REFERENCES

BlazePod presentation. (2017). *URL:https://www.prweb. com/releases/blazepod/2017/prweb14122536.htm (date of request 27.08.2021)*

Chepanov, N., (2021). Training and monitoring of motor responses in karate using a specialized simulator. In *THEORY AND METHODOLOGY OF SHOCK TYPES OF MARTIAL ARTS materials of the All-Russian scientific and practical conference with international participation, dedicated to the memory of Professor, Doctor of Pedagogical Sciences, ZMS of the USSR, ZT of the USSR, K. V. Gradopolov. Moscow, 2021*

FitLight manual. (2021). *URL:https://5cb53c2b-610e-4939-967e-b75d780db3a5. filesusr.com/ugd/da63a6_f116ea2d7f6445f78d546cbd d195bdfb.pdf (date of request 27.08.2021)*

Rogozhnikov, M., Baturin, A., Yakovlev, Yu., Kuritsyna, A. (2020). 'FitLight' training system benefits for neuromuscular control training in basketball. In *Theory and Practice of Physical Culture. 2020. № 9. C.*

Shvab, K., Zakharova, A., Ezhov, A. (2020). Innovative digital technologies for coordination assessment in hockey players. In *Materials of the scientific symposium dedicated to the 95th anniversary of the T&PFC magazine, Moscow, 2020).*

Zakharova, A., Mekhdieva, K., Krasilnikov, V., Timokhina, V. (2019). Soccer Players' Agility: Complex Laboratory Testing for Differential Training. In *7th International Conference on Sport Sciences Research and Technology Support, icSPORTS- 2019.*