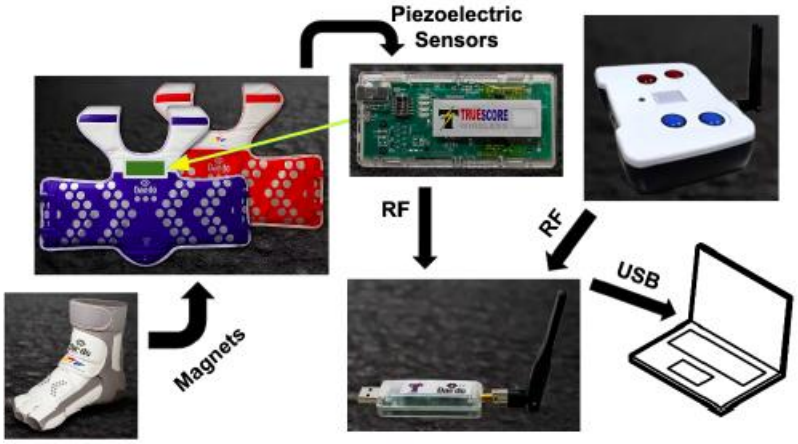

Fig. 1. Electronic protective gear and the scoring system

In order to further improve the accuracy of judging, this study proposes a judging assistance system for the WTF's electronic protective gear. This system combines the quantification of the pressure values of the protective gear with artificial intelligence (AI) visual intelligent analysis.

Based on the existing electronic protective gear, the system integrates pressure sensors to quantify the striking force, and uses AI visual technology to analyze the technical movements of athletes.

It can accurately evaluate key indicators such as the striking force, technical scores, and valid scoring areas.

The aim of this study is to provide a more objective, accurate, and efficient judging solution for taekwondo competitions in the era of the WTF's electronic protective gear, and to promote the development of this sport to a higher level.

References

1. Haili, Li Impact of electronic protectors on the use of techniques and tactics in competitive taekwondo // Contemporary sports technology. – 2022. – 12 p.

2. Ji Xin, Ma Yong, Liu Lin, Yang Zizhe, Lin Shijie, Jia Mengyao. Biomechanical characteristics of taekwondo athletes based on the score of Daedo electronic protective gear [A] Summary collection of the 13th National Sports Science Conference – Special report (Sports Engineering Branch) [C]. – Chinese Sports Science Association, Chinese Sports Science Society, 2023:3.

3. Li J. Analysis of the influence of electronic protective gear on taekwondo competition / J. Li, Y. Xiao, S. Bao // Wushu Research. – 2021. – V. 6.

УДК 796.034.6

CONSTRUCTION OF A REAL-TIME FEEDBACK SYSTEM FOR BASKETBALL SKILLS AND TACTICS AND ATHLETES' PHYSIOLOGICAL INDICATORS OF WEARABLE DEVICES AND AI LARGE MODELS

Master's student gr. 51313224 Yuan Huanglong[1, 2]
Ph.D., associate professor Scherbakova E. N.[1]
[1]Belarusian National Technical University, Minsk, Belarus
[2]Anhui Vocational College of Art, Anhui, China

The intelligent development of basketball has put forward a revolutionary demand for the ability to analyze training and game data in real time. In this study, we innovatively construct a basketball sports intelligent analysis system based on multi-modal data fusion, and achieve a double breakthrough in the dynamic analysis of technical and tactical skills and the monitoring of athletes' physiological status through the deep collaboration between wearable devices and artificial intelligence large models.

In this study, a distributed wearable sensor network (integrating 9-axis IMU, PPG biosensor and UWB positioning module) [1, 2] was used to capture the six-dimensional attitude data of athletes in real time (with an accuracy of ±0,5°) and spatial trajectory (positioning error < 10 cm) and core physiological

parameters (heart rate, blood oxygen, muscle oxygen saturation, sampling rate 100Hz) to construct a multi-dimensional data cube for basketball-specific sports.

Through the hybrid architecture of Transformer-XL timing model and Graph Neural Network (GNN), the system realizes three levels of intelligent analysis:

1. At the tactical level, the attack and defense sequences are reconstructed based on the spatio-temporal attention mechanism, and the tactical patterns are identified in real time and a dynamic game matrix is generated;

2. At the action level, the lightweight 3D attitude estimation model (parameter < 5 M) is used to realize the evaluation of the shooting mechanical chain and the compliance detection of the defensive posture;

3. At the physiological level, the LSTM-Transformer hybrid model was used to predict the fatigue inflection point of athletes (prediction error rate < 8 %), and an early warning mechanism for injury risk classification was established.

The empirical results show that compared with the traditional video analysis system, the proposed system shortens the response time of tactical recognition from 12,3 s to 0,8 s ($P < 0,01$), expands the dimension of action analysis by 4,2 times, increases the success rate of tactical execution by 19.7 %, and reduces the incidence of acute injury by 34.5 % [3, 4]. At the same time, the research reveals the dual challenges of technology implementation:

1. Real-time edge computing optimization of multi-source heterogeneous data (up to 2.1 TB/field).

2. Design of federated learning encryption framework for biometric data.

The technical paradigm proposed in this study provides a reusable technical framework for the digital transformation of collective ball games, and opens up a new path for the intelligent upgrading of competitive basketball and mass basketball.

References

1. The 9-axis MEMS-IMU Real-time Attitude Estimation Algorithm / Zhang Jinyi [et al.] // Journal of Shanghai University (Natural Science Edition). – 2015. – 21 (05). – P. 547–559.

2. Ma Xianmin, Cui Yuancheng, Li Fang. Human Motion Data Mining Algorithm based on wearable nanobiosensors [J]. Smart Computer and Application. – 2024. – 14 (08).

3. Jiang Wave Wave. Research on the Application of Wearables in Exercise Training. Contemporary Sports Science and Technology. – 2024. – 14 (31).

4. Deng Wei. Summary of the Application and Development of Artificial Intelligence in Basketball Sports Training [C] Shaanxi Sports Science Society, Shaanxi Student Sports Association. – 2024.

УДК 796.346.2

BIOLOGICAL BASIS, TECHNICAL EFFICIENCY, AND USE OF MEMS SENSORS FOR ASSESSING TRUNK POSITION IN TENNIS

Master of group 51313224 Tan Jiang Yan
Senior Lecturer Liutsko K. S.
Belarusian National Technical University, Minsk, Belarus

As a highly dynamic competitive sport, the space-time accuracy of technical movements depends heavily on the stability and adaptability of body posture.

About 65 % of technical errors in professional tennis can be traced back to postural deviations (such as center of gravity shift and breakage of the power chain), while the contribution rate of postural errors exceeds 70 % of amateur players' chronic sports injuries (such as tennis elbows and shoulder sleeve tears) (Kibler & Safran, 2005).

The essence of tennis hitting is the process of transmitting the kinetic energy of the ground reaction force through the lower limb → hip → core → upper limb. When the center of gravity sits behind causing the hitting point to lag behind (> 10 cm from the ideal position), the kinetic energy loss is ≥ 15 %. The compensatory force of the shoulder and elbow joints reduces the acceleration of the racket by 20 %–30 %. Wrong posture significantly increases the joint shear force and rotational moment.

Therefore, when tering the ball, the lateral flexion angle of the spine is < 10° to reduce the lumbar load.Using the «hip-dominated» power mode, the contribution rate of the lower limbs is increased from 40 % to 60–70%.Strengthen the shoulder sleeve muscle group (upper muscle, lower muscle) through