

Application Prospects and Feasibility Analysis of Artificial Intelligence in the Sport of Taichi

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Abstract: Artificial intelligence, as an emerging discipline, integrates various disciplines such as computer, mathematics and psychology, and has been rapidly developed and widely used in the era of digital economy, which is an advanced and leading technology field. In recent years, with the deepening of China's economic development and reform and opening up, China has also paid more and more attention to innovation and development in the field of artificial intelligence, and in the context of the construction of a strong sports nation, the Chinese government has proposed guidelines on artificial intelligence technology to empower the sports industry, with the aim of further promoting the deep integration of artificial intelligence with the development of the sports industry and continuously fostering new industries, new models and new experiences in the sports industry. In the 2018 government work report, Premier Li Keqiang proposed to deepen the structural reform on the supply side, strengthen the research and development application of a new generation of artificial intelligence, and promote "Internet+" in multiple fields including sports. In September 2019, the General Office of the State Council released the "Outline for the Construction of a Strong Sports Country", which clearly proposes to accelerate the development of the sports industry through artificial intelligence. Promote innovation in the production methods, service methods and business models of the sports industry, and promote the development of the sports industry and improve quality and efficiency. Taichi (Taijiquan) originated from the ancient Taoist martial arts in China and is a traditional sport with strong national characteristics. Many Party and State leaders, including Mao Zedong, Zhou Enlai, Deng Xiaoping and Xi Jinping, have strongly advocated and supported the sport of Taijiquan. This great sport not only contains a rich philosophy of technique and combat, but also has a strong fitness effect, and has a wide mass base, and is one of the most popular sports in the world. However, in the context of the emergence of various new sports nowadays, Taijiquan has been affected to some extent, with a trend of decreasing attractiveness and participation. Therefore, at a time when the country is building a strong sports nation and proposes artificial intelligence to promote innovation in the sports industry, it is of practical significance to think about how to use artificial intelligence technology to promote the better and faster development of Taijiquan sport.

1 INTRODUCTION

The elaboration of sports in the 14th Five-Year Plan and the outline of the 2035 Visionary Goals indicates that a strong sporting nation has been elevated to a national strategy, and in the Outline for the Construction of a Strong Sporting Nation issued by the State Council, five strategic tasks are proposed (Securities Times 2019), one of which emphasizes the promotion of the intelligent development of national fitness and the implementation of the national fitness strategy to help build a healthy China.

On November 8, 1953, Taijiquan made its debut as a performance item at the National Ethnic Sports Performance and Competition Conference held in Tianjin. In October 1990, the International Wushu Federation was established in Beijing, and Taijiquan, as an important part of the official organization, has been recognized by martial arts enthusiasts worldwide. The International Martial Arts Federation has more than 120 member countries or member organizations, different levels of Taijiquan associations are spread all over the world, and the sport of Taijiquan has initially formed a sports

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industry form that focuses on events, fitness, training, equipment and cultural exchange. While acknowledging the many advantages of Taijiquan development, we should also see that there are still problems in the further development of Taijiquan, including limited attractiveness of events, insufficient innovation in teaching mode, unsatisfactory experience, poor organizing approach, and uneven age distribution of fitness practitioners. The authors believe that, based on the country's strong call to strengthen the empowerment of artificial intelligence in the field of sports, practitioners of sports, especially of martial arts, should seriously comprehend, actively commit and take the initiative to comprehensively promote the healthy development of Taijiquan sport with the concept and technology of artificial intelligence, optimize and even solve the problems in development with the targeted help of artificial intelligence technology, so that Taijiquan, in the changing times, always maintains high attention and high participation, and become an important driving force on the road to a strong sports nation.

2 ASPECTS OF THE SPORT OF TAICHI NEEDED TO BE OPTIMIZED FROM THE PERSPECTIVE OF ARTIFICIAL INTELLIGENCE

2.1 Competition Aspect

2.1.1 Inadequate Optimization of Competition Organizing Process

There are various forms of Taijiquan events, some of which are included in large martial arts events, some of which are separate Taijiquan martial arts events, which include professional competitions or fitness competitions for all. The participant groups of martial arts events, especially Taijiquan events, are more complicated, divided into internal and external groups of the events. Internal groups are those directly connected with the events, including judges, coaches, athletes, media, sponsors, spectators, etc.; external groups are those indirectly connected with the events, including caterers, retailers, tour operators and other related groups (Zhou 2014).

The on-site qualification of athletes, the entrance security check and ticket inspection of spectators and event-related personnel are usually verified by volunteers or staff organized by the event organizers. Especially for large domestic and international

Taijiquan events, the participating groups are huge and there are a considerable proportion of middle-aged and elderly participating athletes. Under such circumstances, without the support of big data and artificial intelligence technology for hardware and software, the labor-based verification process is often not smooth, and is the focus of complaints against some events.

2.1.2 Insufficient Sense of Spectator Experience

Compared to other mainstream sports, the appeal of Taijiquan competitions to the spectators is not strong enough, and the reason for this is mainly the lack of involvement and the sense of experience: Taijiquan competitions are usually held in indoor gymnasiums with martial arts competition carpets laid down to form several competition fields. The spectators sit in the audience and watch the group or individual taichi performances. The problem is that almost all Taijiquan tournaments do not have live streaming video through quick editing of competition highlights and intelligent switching of close-ups and distant shots. Spectators sitting far away can only see a basic outline of movements like watching a group gymnastics performance, and it is difficult to feel the details of the athletes' movements and the unique beauty of Taijiquan's physical and divine coordination. In addition, Taijiquan events generally do not have any interactive content for the audience to participate in, often forming a "you practice your own, I watch mine" situation. The lack of vitality and interactivity of the event has led to a certain degree of declining interest and lack of experience for the audience.

Table 1: Basic scale of participation in large Taijiquan events.

| Tournaments | Range of teams | Number of athletes |
|---|---|--------------------|
| The 17th Hong Kong International Wushu Festival | 242 domestic teams, 12 foreign teams | 2600+ athletes |
| The 10th China Jiaozuo International Taijiquan Exchange Competition | 59 countries and regions | 4000+ athletes |
| The 14th China-Handan International Taijiquan Sports Conference | 27 countries and 30 domestic provinces and cities | 1288 athletes |

| | | |
|---|-------------------------------------|----------------|
| The 7th China (Rizhao) Daqingshan International Taijiquan Competition | 40 countries and regions, 160 teams | 2100+ athletes |
| The 8th World Traditional Wushu Championships | 48 countries and regions | 5300+ athletes |

2.1.3 Competition Judging Is Prone to Controversy

As a rating sporting event for difficult and aesthetic movements, professional Taijiquan competitions have very clear scoring criteria for the specification and difficulty of movements (see table below). Although the scoring system is constantly revised and refined, in high-level competitions, where the differences in player levels are slight, the recognition and deduction of points for the completion of difficult or innovative movements has a huge impact on the competition results. Although referees are generally certified and have some experience in officiating, there is still a certain degree of subjectivity in assessing the quality of specifications and difficulty of movements, and some key deduction points can easily cause controversy.

Table 2: Difficulty classification of self-selected Taijiquan routines.

| Categories | Class A | Class B | Class C |
|-------------------------|--|---|----------------------------------|
| Balance category (code) | Front leg lifting with low stance balance (143A) | Rear leg thrusting with low stance balance (143B) | Side skyward kick upright (113C) |
| Legwork category (code) | Kick or split leg (212A) | Flying front kick (312B) | Flying lotus swing 540° (324C) |
| Jumping category (code) | Flying kick in the air (312A) | Soaring flying kick inward turn 180° (322B) Spinning kick 360° (323B) Soaring air swinging lotus 360° (324 B) | Spinning kick 540° (323C) |

2.2 Training Aspect

2.2.1 Conventional and Simple Training Mode

Before the implementation and promotion of the classroom system, the teacher-apprentice teaching mode was the main teaching mode in martial arts inheritance (Li 2017). The class teaching system was formed on the basis of the criticism and improvement of the elite teaching mode of teacher-apprentice system, and the teaching and training of Taijiquan is also based on these two modes. Because of the simple training design and monotonous training content, practitioners tend to accept and learn passively, and their enthusiasm and initiative may be adversely affected in the long run.

2.2.2 Quality and Effectiveness of Training Are Difficult to Guarantee

The quality of Taijiquan training largely depends on the grasp of key technical essentials and the control of body and step patterns. Professional Taijiquan athletes often have fixed coaches for targeted instruction, while amateurs generally find their own masters, enroll in club training courses, or have the community arrange for designated social sports instructors to practice. Whether professional or amateur, Taijiquan exercise mainly relies on the words and physical teaching of the instructor. If the level of coaching lacks quality, even in the case of equal basic conditions of students, some key movements, body shapes and technical essentials of Taijiquan are difficult to walk on the correct technical track, and the final training quality and results are likely to be very different.

3 APPLICATION PROSPECTS OF ARTIFICIAL INTELLIGENCE TECHNOLOGY IN TAICHI

3.1 Artificial Intelligence Technology Optimizing Taichi Tournaments

3.1.1 Process Optimization of Tournaments

In the identity verification process of Taijiquan events, especially large events, artificial intelligence technology is introduced to combine information intelligent management technology, face recognition technology and self-service technology to realize

self-service ticket checking, identity verification, gate automation and other services. Through the artificial intelligence system the permissions of different staff could be set to facilitate the work of the relevant personnel and to prevent others from maliciously tampering with the system. Which can ensure the clear scope of activities of the personnel in each area of the venue, making the management of the venue more standardized, improve the efficiency of access to the competition venue and the satisfaction of the participants.

3.1.2 Optimize the Viewing Experience

Taijiquan exercises are characterized by graceful and flowing movements, which are beautiful and highly aesthetic, in line with the laws of human movement aesthetics. The essence, energy, and charm of the high-level Taijiquan performers are reflected in the details of their movements, which richly express the cultural connotation of Taijiquan. Through artificial intelligence technology, the details of the body and expressions of the athletes' performance can be collected on site in real time, and the essence of the performance can be synthesized at the first time, and the video clips can be automatically generated and output to the big screen on site, so that the audience can have a better viewing experience. At the same time, artificial intelligence machines can be introduced outside the competition arena, such as entrance and exit routes, public activity spaces and other areas. Some games and experience sessions with Taichi elements could be implanted in advance, so that ordinary spectators could participate in the games. For example, participation in the AI Taichi Challenge during the break between matches, with automatic scoring by comparing AI with standard movements, enriches the viewing experience and deepens the understanding of Tai Chi movement.

3.1.3 Intervening in the Recognition of Key Technical Movements

In the Taijiquan competition venue, artificial intelligence cameras and intelligent motion capture systems, etc. can be installed to intelligently analyze the degree of difficulty coefficient movements made by athletes through AI technology, assist in cooperating with judges to make decisions on the completion of such technical movements, and provide timely feedback to on-site judges to avoid mistakes or errors in deducting points. When other teams or spectators have disputes, they can also quickly provide strong technical data to dispel doubts

and questions and ensure the openness and fairness of the competition.

3.2 Integration of Artificial Intelligence Technology into Taichi Training

3.2.1 Improving the Quality of Taijiquan Training with Artificial Intelligence-assisted Training System

By developing special intelligent data analysis software and implanting the correct movement technical data in advance, a special artificial intelligence assisted training system can be created by using monitors, receivers, etc. as carriers. Through the motion capture technology of artificial intelligence, the 3D motion graphics containing athletes' speed, motion accuracy and other data will be displayed in real time, and the key technical movements of athletes will be analyzed intelligently to produce technical feedback. And the AI program will accumulate dynamic data of athletes and analyze them, providing coaches and athletes with technical data with tracking value, helping to make timely training content adjustment and effectively improve training quality.

3.2.2 Reasonable and Effective Use of VR Technology

The first is that professional Taijiquan athletes can learn through VR smart glasses equipment to imitate the movements of outstanding athletes in depth and strengthen the technical maturity and stereotypes of the movements, and also to simulate and rehearse the competition venue in advance before the competition by projecting the virtual environment, which is more helpful to the athletes' psychological adjustment during the competition. Secondly, in the public-oriented Taijiquan training, virtual reality devices can be used to interact with the virtual world, such as setting scenes in iconic venues with great characteristics of taiji elements like Wudang Mountain Dojo, with taiji music or human voice prompts, so that practitioners can feel like they are in the real world and improve the attractiveness of training contents and the enthusiasm of mass participation.

3.2.3 Development of Artificially Intelligent Tai Chi Training Outfit

Smart outfit belongs to a kind of garment that has both sensing and reacting functions, which is a

collection and feedback system of internal and external information of the body. It not only senses changes in the external environment or internal state of the body, but also responds to such changes in real time through a feedback mechanism, thus making the outfit an intelligent "feeling" (Huang 2015). For example, Wearable X's Nadi yoga pants have five tactile sensors embedded in the hip, knee and ankle sections of the pants, which are interfaced with the yoga pants through the Nadi App on the cell phone via Bluetooth and provide feedback through vibrations. The app is able to teach yoga poses or guide you through the movements with electric currents that direct you to adjust your posture.

Taijiquan places extreme importance on body posture and the pursuit of correct posture, with a focus on form before intention. Only by following certain specifications and maintaining correct posture throughout the coherent and complex movements, so that the posture of each body part forms a dynamic stereotype in the overall movement, can we achieve the standardization and automation of the techniques and eventually promote the level of improvement. Therefore, it is especially necessary to develop an intelligent training outfit according to the technical specification requirements of Taijiquan. The authors' vision is that the smart training suit captures body posture data through built-in sensors and feeds movement information into an app in a timely manner, which will instantly remind athletes of obvious posture errors during an exercise performance by means of vibrations or beeps, etc., as a virtual technical guidance aid to improve athletic competition.

Table3: Taijiquan artificial intelligence technologies/ devices application table (recommended).

| Categories of scenarios | Artificial intelligence technologies/devices | Remarks |
|-------------------------|---|--|
| Tournament scenario | Information intelligent management technology | Used to optimize the tournament process and tournament experience |
| | Face recognition technology, self-service ticketing, identity verification, gate automation | |
| | Artificial intelligence cameras, artificial intelligence video editing software | |
| | Artificial intelligence interactive robot | |
| Training Scenario | VR smart glasses equipment | Used to assist in improving training level and practice motivation |
| | Artificial intelligence assisted training system | |
| | Artificial intelligence taiji training outfit | |

4 CONCLUSIONS

General Secretary Xi Jinping has emphasized that a new generation of artificial intelligence is flourishing globally, injecting new momentum into economic and social development and is profoundly changing people's production and life style (Xinhua News Agency 2018). The author believes that, as a member of the sports and of the martial arts community, on the road to the construction of a strong sports nation, we should follow the trend of the times, innovate our ideas, and make better use of artificial intelligence technology, the most cutting-edge high technology in the Internet+ era, to vigorously promote the development of Taijiquan, so that this Chinese national treasure always has great appeal and more people of different age levels would join the sport. This is also the practical embodiment of people in the martial arts community striving to be the promoter and practitioner of the construction of a strong sports nation.

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