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Retraction

Retracted: Tennis Technology Recognition and Training Attitude Analysis Based on Artificial Intelligence Sensor

Journal of Sensors

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This article has been retracted by Hindawi following an investigation undertaken by the publisher [1]. This investigation has uncovered evidence of one or more of the following indicators of systematic manipulation of the publication process:

(1) Discrepancies in scope
(2) Discrepancies in the description of the research reported
(3) Discrepancies between the availability of data and the research described
(4) Inappropriate citations
(5) Incoherent, meaningless and/or irrelevant content included in the article
(6) Peer-review manipulation

The presence of these indicators undermines our confidence in the integrity of the article's content and we cannot, therefore, vouch for its reliability. Please note that this notice is intended solely to alert readers that the content of this article is unreliable. We have not investigated whether authors were aware of or involved in the systematic manipulation of the publication process.

In addition, our investigation has also shown that one or more of the following human-subject reporting requirements has not been met in this article: ethical approval by an Institutional Review Board (IRB) committee or equivalent, patient/participant consent to participate, and/or agreement to publish patient/participant details (where relevant).

Wiley and Hindawi regrets that the usual quality checks did not identify these issues before publication and have since put additional measures in place to safeguard research integrity.

We wish to credit our own Research Integrity and Research Publishing teams and anonymous and named external researchers and research integrity experts for contributing to this investigation.

The corresponding author, as the representative of all authors, has been given the opportunity to register their agreement or disagreement to this retraction. We have kept a record of any response received.

References

[1] K. Li, "Tennis Technology Recognition and Training Attitude Analysis Based on Artificial Intelligence Sensor," *Journal of Sensors*, vol. 2022, Article ID 6594701, 7 pages, 2022.

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Research Article

Tennis Technology Recognition and Training Attitude Analysis Based on Artificial Intelligence Sensor

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In order to solve the problem of traditional tennis serving technique teaching, subjective, and experience-based teaching methods, the author proposes a method to extract tennis training movements based on artificial intelligence sensor video analysis. This method requires the use of ordinary cameras and computer technology; video analysis technology is used to guide tennis teaching and training. The result obtained is as follows: in the experimental group and the control group, at the end of the teaching stage, the movement characteristics of each link of the body are quite different, which can reach 15%-20%; when the experimental group and the control group did the "scratching back" movement during the teaching period, at the end of teaching, the students in the experimental group were close to high-level tennis players in their movement skills, and the movement gap was only about 5%. It is proved that the method proposed by the author provides an objective and scientific basis for measuring the referee's penalty level. In the grass-roots tennis teaching and training, it has important value and significance and has a great promotion prospect.

1. Introduction

Video images obtained by humans use a variety of images and devices to observe the world from a different perspective, which directly and indirectly affect the human eye and create visual acuity, for example, static images or dynamic videos [1]. According to research and statistics, about 75 percent of the information that a person receives from the outside world is from vision. With the rapid development of science and technology, sports technology has played an important role in national leadership and sports [2]. With the introduction of the use of technology in sports training and the emergence of new research to make a difference in the study of physical education, training teaching training has not been completed previously. With the improvement of sports competitive level, the training method which only relies on the coach's intuition in the past has been unable to improve the competitive level [3]. The development of computer and video technology makes it a new tool for trainers, because the machine's vision is more real than the human eye, it has memory, it can hold the target fast, and it can record various moves of the target and allows the performance of the athlete to be clearly expressed [4].

Video image processing technology is more and more widely used in athletes' sports training and sports competitions [5]. It has become a research hotspot, in foreign countries, such as the United States; the "Eagle Eye" test system has been applied to tennis competitions; it is mainly used to monitor the game; when the player disagrees with the landing position of the tennis ball, the three-dimensional image of the landing position of the ball can be retrieved [6]. In China, the Institute of Computing Technology of the Chinese Academy of Sciences has developed DVCoach software, which applies video analysis to sports training and teaching. The prices of these systems are very high (hundreds of thousands or even millions of RMB) [7]. In general physical education and training, such a huge investment cannot be afforded. And these systems have certain pertinence to a certain sports activity. The hardware composition of tennis video analysis system is shown in Figure 1.

In addition, the video data is analyzed, and the corresponding court and tennis recognition algorithms are

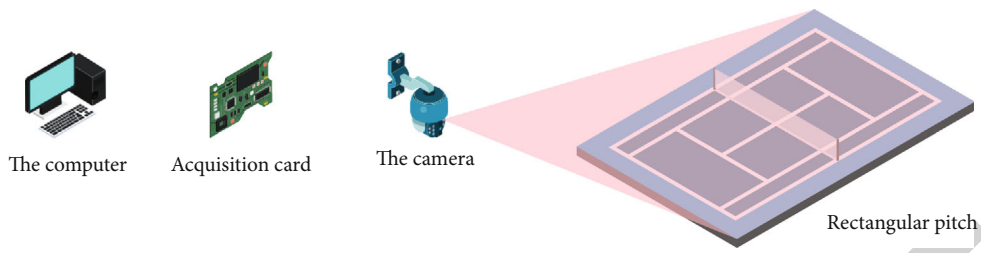

Figure 1: Tennis video analysis system hardware composition.

designed; it can automatically judge whether the tennis is out of bounds, automatically measure the running speed of the tennis space, and deal with it accordingly, so as to provide a scientific basis for the development of tennis teaching and training effect evaluation system.

2. Literature Review

The tennis video analysis system consists of hardware and software. The main research tools used include optical lenses, CCD cameras, image acquisition, and research and design of processing cards [8]. With the help of video professionals, the video analysis algorithm is designed and implemented on the computer, so as to meet the requirements for the use of video data in the author's research [9].

According to the image processing recognition algorithm and the characteristics of the court, the characteristics of the high speed of tennis properly select the resolution of the CCD camera and the sampling rate of the frame grabber, in order to form a high-quality image information acquisition system, ensure reliable image sampling and digitization, and provide correct and reliable raw data for subsequent image signal processing [10]. In terms of software, DirectShow acquisition technology is used to realize digital video acquisition [11]. Features are as follows: (1) high-quality digital video capture is achieved through intelligent dejitter technology and deinterlacing technology and (2) support multicamera head acquisition.

Cheng et al. studied the application of traditional teaching methods and information technology teaching methods in the teaching of tennis serve technique, the video technology is mainly used in the teaching of information technology, and the experimental research shows that the teaching of information technology is more superior than the traditional teaching method; it is the same trend of teaching technology development in the future [12]. Gao et al. use video technology to analyze the action structure of tennis players' serve technique; no further research was carried out in the application analysis of video technology of tennis speed and landing point [13]. Sun et al. conducted a research on the application of video technology in the production of tennis multimedia CAI courseware and did not conduct further analysis and research on the data of video technology [14]. Srivastava et al. conducted an experimental study on improving tennis forehand stroke technique using computer-aided teaching methods [15]. Chen et al. proposed a motion vector field transformation algorithm for tennis video analysis [16]. The above research results mainly show the research on teaching methods and how video technology is used in tennis sports, the main purpose of the research is the use of video technology and the video technology itself, few special researches are carried out on the data obtained by video analysis technology, the instruments and software used are relatively professional, and the hardware facilities are very expensive, which is difficult for most researchers to accept and access, and it is very difficult to promote in reality [17].

In addition, there are other applications of this technology in the field of sports, such as the application of video technology in the analysis of techniques and tactics of table tennis, research on the application of video technology in aerobics teaching, diving technique training video analysis and quick feedback system, talking about the application of video technology in swimming teaching and training, the development of video image technology and its application in track and field training, and 3D human motion simulation and video analysis system for sports training. The above research results show that video technology, as a high-tech means, has achieved good teaching and training effects in table tennis, aerobics, diving, and other projects, and the research angles are different [18, 19]. From the perspective of video technology, some analyze which video technology is used or how to improve the existing video technology for analysis and research. Some conduct research from analytical feedback systems. Some conduct research from images [20, 21].

Based on current research, the author proposes the application of video analysis to tennis teaching training and competition, it can quickly provide coaches and athletes with data such as the technical action structure diagram of the athlete's serve, the speed of the serve, and the landing point; it can not only reduce the cost of using expensive equipment but also provide scientifically quantified index data for the tennis evaluation system. Video technology can provide a reference for referees to accurately determine the placement of tennis balls in the game, effectively avoid the embarrassment of using "hawk-eye" technology in small and medium-sized tennis events, and obtain maximum returns with less investment.

3. Research Methods

3.1. Research Objects. Select high-level tennis players (higher than level 2), and show real-time combat videos of the game based on statistics equipment. Select 40 boys from the specialized tennis college according to the educational goals.

The median age of the test students was 20.4, average height 173.25 cm, and average weight 65.63 kg. The average length of the arm was 73.16 cm.

The average age of the students in the control room was 20.5, average height 172.87 cm, and average weight 64.72 kg. The average length of the arm was 72.69 cm.

3.2. Adoption Method

3.2.1. Document Law. The author carefully read the relevant information about tennis and systematically reviewed the articles about tennis published in recent years, keep abreast of the new achievements in the research and application of video technology in sports, study and analyze the problems of video technology in tennis teaching and training, and provide reference for the research of this topic [22].

3.2.2. Interview Method. The author conducts interviews with tennis coaches, experts, and administrators to hear their detailed descriptions of tennis teaching and training. They also conducted interviews with experts engaged in video technology and computer technology, helping to conduct research on video technology and design of video software, thereby summarizing, researching, and analyzing. The main contents of the interview are as follows: the status quo of tennis teaching and training, the application of video technology and software programming involved in tennis teaching and training, etc. [23].

3.2.3. Experimental Method. During the experiment, the training items, training intensity, training time, and teachers of the two groups were the same.

The 06 special-grade tennis students selected were divided into control and experimental groups, and the procedures for the student groups did not vary by age, height, weight, or arm length.

The board uses the usual procedures of the instructor to explain, demonstrate, and practice. Experimental teams combine video analysis, feedback, and routines to teach the experimental team and the board a video of the process to be used in the first place phase and late, and special instructions must be used in the end. The inspection and control teams were compared and evaluated.

3.2.4. Comparative Method. The technical movements of the high-level tennis players were compared with those of the students in the control group and the experimental group; for students in the experimental group and the control group, a comparative analysis is made based on the technical characteristics of serving at the end of teaching and so on [24].

3.2.5. Mathematical Statistics. The obtained statistical data were subjected to routine statistical analysis. Using a variety of mathematical methods and SPSS and EXCEL software systems, a database was established to conduct statistics on the data [25].

3.3. Application of Video Analysis in the Technical Action Structure of Tennis Serve. The application of tennis serving skills is often carried out at a relatively high speed, it is difficult for the naked eye to observe every detail of the athlete's skills, and it is impossible to form a deep "action impression" in the brain, and it is impossible to store this kind of "action" for long-time action impressions." It is also difficult for the coaches to guide and evaluate the technical details of the athletes. Through video analysis, each technical detail of the athlete can be clearly obtained, and through feedback, it can be observed and compared intuitively, so as to further improve the technical movement level of the athlete.

Table 1: The time difference between the throwing and hitting of the students in the experimental class (unit: second) ($n = 10$).

	Average value at the beginning of teaching	End-of-teaching average
B0	4.04	2.72
B1	4.32	2.96
B2	448	2.32
B3	3.92	2.48
B4	3.84	2.52
B5	3.90	2.44
B6	4.08	2.64
B7	4.28	2.32
B8	4.24	2.44
B9	4.32	2.52

Through video analysis, every detail in the technical link of the athletes can be obtained, and static pictures of the structural details of the students' serving actions can be collected; coaches can guide athletes through pictures and can also compare and analyze the same technical details of different athletes; it is also possible to compare the technical details of student-athletes with the technical details of high-level tennis players, in order to identify gaps. High-level tennis players may have individual differences and characteristics in the use of technical details; by analyzing their different technical details and characteristics through video technology, it is also possible to find out the common and regular technical details of technical details.

3.4. Application of Video Analysis in Tennis Serve Speed Test. In the evaluation of tennis technical level, coaches usually can only use subjective qualitative evaluation to evaluate the movement posture of the players, the landing point of the ball, and the speed of the serve. However, a correspondingly accurate quantitative assessment cannot be given. Through video analysis, we can use the acquired tennis flight image and then perform programming and calculation through image recognition software and can quickly measure the speed of the player's serving over the net.

Use video technology to obtain static images between two adjacent frames (0.04 seconds) when the tennis passes the net. From the logo on the background (the black and white interval is 0.1 meters), we can roughly calculate that the running distance of the tennis ball between these 0.04 seconds is 1.7 meters. From the formula (1), it can be calculated that the speed of the serve before the net reaches

Table 2: The time difference between the throwing and hitting of the students in the control class (unit: second) ($n = 10$).

	Average value at the beginning of teaching	End-of-teaching average
Co	4.48	3.64
CI	4.32	3.72
C2	4.32	3.76
C3	4.04	3.52
C4	4.44	3.44
C5	4.24	3.52
C6	452	3.36
C7	4.00	3.52
C8	3.84	3.24
C9	3.92	3.20

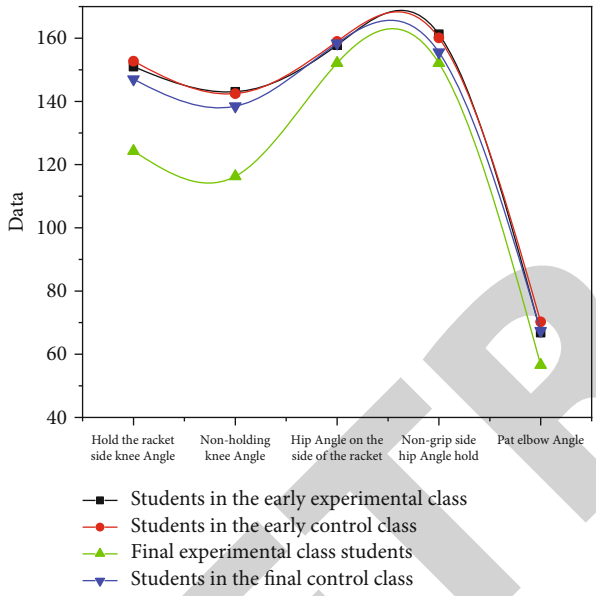

Figure 2: Comparison of the action structure of students before and after the experiment when they bend their knees, raise their rackets, and prepare to hit the ball (unit: degree) ($n = 10$).

42.5 meters per second (153 km/h).

$$V = \frac{S}{T}. \quad (1)$$

Although there will be a large error between the results obtained by this calculation method and the actual results, the error can be ignored when comparing the serving speed between players. The error value of this calculation method can also be calculated through correction, so as to achieve the purpose of simply testing the serving speed.

4. Analysis of Results

4.1. Statistical Analysis of the Time Difference between Toss and Hits in the Serve of the Research Object. Serving technique is a difficult point in tennis teaching, and the rhythm of throwing and hitting is one of the more difficult links in serving technique. The route and height of the toss will directly affect the difficulty and accuracy of the serve. The author made statistics on the time difference between tossing and hitting in 10 consecutive servings at the beginning and end of teaching, record the athlete's serve action with a video recorder, store it in the computer, and drag it frame by frame with the Photo 9 software; the number of frames used is multiplied by 1/25 second, which is the time difference between the player's throwing and hitting the ball, which greatly reduces the amount of time spent and error in manual stopwatch timing (see Tables 1 and 2).

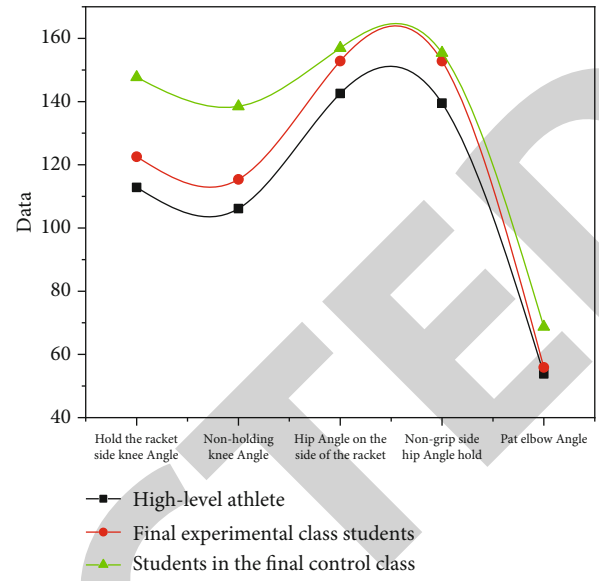

Figure 3: Comparison of action structure between students and high-level athletes when they bend their knees, raise their rackets, and prepare to hit the ball after throwing the ball (unit: degree) ($n = 10$).

All the measured data, using SPSS, conducted a T test on the time difference between throwing and hitting in 10 consecutive servings at the beginning and end of teaching. The result shows the following: the average value of the time difference between throwing and hitting the ball in the experimental class and the control class is basically the same in the early stage of teaching, and there is no significant difference ($P > 0.05$).

The average value of the time difference between throwing and hitting the ball in the experimental class was between 3.84 and 4.48 in the early stage of teaching, and the average value of the time difference between tossing and hitting the ball in the control class was between 3.84 and 4.52. However, the average time difference between the experimental class and the control class at the end of teaching is significantly different ($P < 0.05$).

The average value of the time difference between tossing and hitting the ball at the end of teaching in the experimental class is between 2.32 and 2.96, and the average value of the time difference between tossing and hitting the ball in the control class at the end of teaching is between 3.20 and

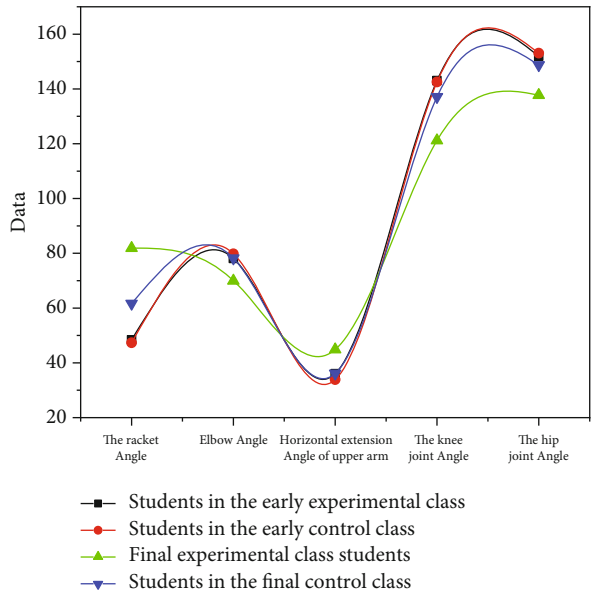

Figure 4: Comparison of the posture characteristics of each link of the body when students scratch their backs before and after the experiment (unit: degree) ($n = 10$).

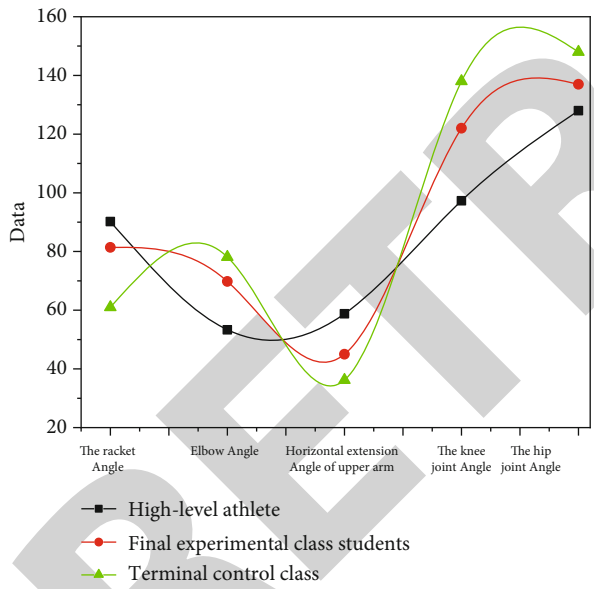

Figure 5: Comparison of the posture characteristics of each link of the body when students and high-level athletes scratch their backs (unit: degree) ($n = 10$).

3.76. Although there is difference between the throwing and hitting times at the end of the teaching period between the experimental class and the control class, it is shorter than the initial stage of teaching, but through the above data test results, it can be seen that the subjects in the experimental class performed much better than those in the control class.

4.2. Analysis of the Movement Structure of the Research Subjects when They Bend Their Knees, Raise Their Rackets, and Prepare to Hit the Ball after Throwing the Ball. In the stage of throwing the ball and raising the racket, make an

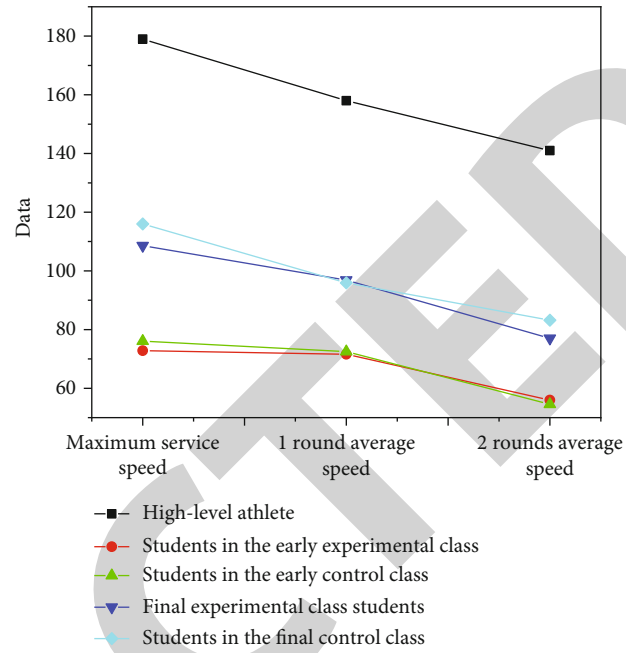

Figure 6: Statistical summary table of students' serving speed at the end of the video test (unit: KM/H) ($n = 10$).

obvious knee squatting action, this is an important part of the technical action structure of the serve, and its purpose is to provide good body support and a state of force for the "back-scratching" action.

In the specific throwing racket, the posture characteristics of each link of the body when preparing to hit the ball are shown in Figures 2 and 3.

According to the above data analysis, the experimental group and the control group have a large difference in the movement characteristics of each link of the body at the end of the teaching stage, which can reach 15%-20%; compared with the students in the control group, there was little change in the beginning of teaching and the end of teaching. Compared with the students in the experimental group at the beginning and end of teaching, there were obvious changes, the students in the experimental group were in the final stage of teaching the movement techniques, and it is closer to a high-level tennis player than the initial movement technique.

4.3. Structural Analysis of the Object's Back-Scratching Action while Serving. At the end of throwing the ball and raising the racket, the athlete will quickly kick the knee and push the hip and at the same time bend the elbow and rotate the upper arm externally, keep the tennis racket away from the hitting point, and keep it behind; the head is almost vertically downward, and the body is in a "back arch" posture. There is a movement to tickle the back, which we call a "back-scratching" movement. It is also a very important key technical action in the technical link of tennis serving. Through video collection, we analyzed the movement characteristics of the "scratching back" technique of the research subjects. The results are shown in Figures 4 and 5.

According to the above data analysis, when the experimental group and the control group did the "scratching back" movement stage during the teaching period, the movement characteristics of each link of the body were quite different. Compared with the students in the experimental group at the beginning and end of teaching, there were significant changes, the students in the experimental group were in the final stage of teaching the movement techniques, and it is closer to a high-level tennis player than the initial movement technique.

To sum up, in the teaching of tennis serving skills, the use of video analysis technology can eliminate the interference of human factors and more quickly, objectively, and directly evaluate the players' serving skills. Because the shooting speed of the camera is 25 seconds/frame and the video data can be stored, compared, etc., these functions cannot be achieved by the human eye. Athletes can see their own serving skills before the experiment, and they can also see the movements after the experiment; they can not only compare and analyze with others horizontally but also realize vertical analysis, thereby greatly improving the enthusiasm and initiative of students to learn tennis skills. It can be seen that in the teaching of tennis serve technology, the application of video analysis technology is of great significance.

4.4. Comparison of Effective Rates of Urinary Incontinence Treatment among Three Treatment Options. Video test speed data, research speed in tennis serve technical action analysis, is an important evaluation standard for tennis serve quality; a high-quality serve must have a high speed. The related research results show that the more standard and reasonable the technical action of serving is, the faster the serving speed will be; the two are positively correlated. The author uses an ordinary camera as a test instrument for serving speed; it is easy to measure the serving speed of tennis players, although there will be certain errors between the data and the objective real data, but it is feasible as a comparison tool, and it can be as close to the real objective value as possible through constant revision. At the same time, as a speed test instrument, ordinary cameras can reduce the test cost and have great promotion value.

The authors tested high-level tennis players, experimental tennis players, and control tennis players; the speed of 10 1 s and 10 2 s served by each athlete was randomly selected for the study. The experimental class and the control class were also researched on the serving speed at the beginning and end of the teaching, and the results are shown in Figure 6.

In summary, using video analysis technology for the teaching of serve technical movements, from the measured speed data, it can be clearly seen that the improvement space of the athlete's serving speed is better than the traditional teaching method, serve speed has been significantly improved, and the improvement of the quality of the athlete's serve is explained. In data measured using video data, it can provide a meaningful reference for coaches to objectively evaluate tennis players' serving skills; at the same time, the athletes can see their own serving skills before the experiment, and they can also see the movements after the experiment and not only can horizontally compare and analyze with others but also can realize vertical ratio analysis, thereby greatly improving the enthusiasm and subjective initiative of the students to learn the tennis serve technique.

5. Conclusion

The author applies video analysis technology to tennis teaching and training, and through a period of teaching experiments, the results are as follows:

(1) The technical movement characteristic parameters of the students in the experimental group are higher than those of the students in the control group, closer to the technical characteristics of high-level tennis players. It is proved that the video analysis technology is used in the teaching of tennis serve technique, it is more conducive to students' mastery of technical movements and can test and judge athletes' serving speed and landing point, and it is beneficial to improve the serve speed and serve control ability of tennis players. Video analysis technology is of great significance and value to the reform of tennis serving technique teaching and serving method

(2) The traditional teaching model is the comments of the coach and the athlete's own feeling of completing the action. In the tennis training process, the video analysis feedback training method is applied; that is, after the athlete completes the action, the athlete immediately watches video recordings of his/her own actions and various analysis results, which is equivalent to adding a video feedback loop to the system. For sports training, the effect will be that athletes can improve their training level more quickly and effectively and shorten the time to learn and master technical movements. Tennis is a typical skill sport

Data Availability

The data used to support the findings of this study are available from the corresponding author upon request.

Conflicts of Interest

The author declares that there are no conflicts of interest.

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