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Application of Multi Information Data Fusion in College Public Sports Basketball Teaching

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ABSTRACT

Due to the deepening reform of quality education, the requirements for physical education teaching in colleges and universities have become increasingly strict. In this era of rapid renewal and development of multimedia information technology, in order to make the traditional sports basketball teaching keep up with the pace of the trend and to search for the future development direction of college public sports basketball teaching, this paper studied the application of multi information data fusion technology in college public sports basketball teaching. The remote sensing technology and global positioning system in the multi information data fusion technology were used to conduct real-time detection and statistics on the sports effects of students in basketball teaching, and the relevant experimental scheme was designed. The data results recorded by manual recording and multi information data fusion technology were compared. The experimental results showed that when three student representatives and remote sensing technology simultaneously counted the times of passing and touching, the success rate of passing and the scoring rate of throwing for four sports members, the accuracy of remote sensing technology was higher; the Global Positioning System (GPS) system could effectively record the running distance, average speed and heart rate of 4 athletes. The average speed of No. 3 athlete was 9.1 m/s; the passing rate and shooting rate were both 50%, and the average speed of No. 4 athlete was 7.85 m/s. The pass success rate was 50%, and the shooting rate was only 33.3%. These data were conducive to teachers' timely understanding of students' personal conditions and basketball level, which could improve the efficiency of college sports basketball teaching and also increase the quality of students' sports. At the same time, the questionnaire survey method was also used to study the results of the introduction of multi information data fusion technology. The findings shown that multi-information data fusion technology might increase students' passion for learning basketball courses, hence improving the quality of sports, by altering their interest and attitude. In order to provide guidance for the future development of college public sports basketball instruction, this study offered a reference value for the application of multi-information data fusion.

Keywords: College Public Sports Basketball Teaching, Multi-information Data Fusion Technology, Global Positioning System, Remote Sensing Technology

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1. Introduction

With the popularity of college basketball, college public sports basketball course has become one of the most popular sports courses for most students. The continuous development of college basketball also makes its disadvantages emerge gradually. The extensive application of multimedia information technology in college classrooms has met the development needs of quality education, but it has also brought unprecedented opportunities and challenges to college public sports basketball teaching. In order to open up a new way for college public sports basketball teaching, it is necessary to introduce multi information data fusion technology. The remote sensing technology and global positioning system should be used to improve the existing teaching methods and environment, and enhance students' subjective initiative, so as to promote the development of students' basketball learning and advance their interest in learning. At the same time, more teaching knowledge should be explored to improve the overall efficiency.

Multimedia information technology has encouraged the reform of collegiate basketball instruction and drawn the attention of academics as the importance of teaching basketball in public schools and universities grows. According to Xu S, when living conditions increased, individuals became more interested in sports and worked on their bodies [1]. Munoz-Bullon F analyzed the impact of participating in extracurricular sports activities on the academic performance of higher education students [2]. Liu J believed that it was of great significance to cultivate basketball interest and develop exercise habits to promote national fitness [3]. Hastie P mentioned that the goal of the new guidelines for Chinese university sports was to promote a higher level of active participation, thus emphasizing the development and cultivation of students' personal abilities [4]. According to Zhang J, a collegiate basketball course is fundamental to students' physical attributes [5]. Chen W talked on how network multimedia courseware can be used practically in college basketball instruction [6]. The state is becoming increasingly concerned with the physical fitness of modern pupils as a result of educational reform and innovation. Sports classes are pluralistic due to a variety of sports teaching strategies. Sports basketball instruction can be made more effective and transparent with the use of multi information data fusion technology.

Many academics have researched how to incorporate these technologies into the educational system because of their role in the current college public basketball teaching mode and the fact that they are derived from the development of multimedia information technology. Ziyu L I U thought that multimedia technology may help students become more competitive and contribute more to the basketball cause in addition to igniting their interest in learning the game and mastering its associated technical level [7]. Li Y mentioned that how to integrate multi information data into the learning system was a key step for successful analysis [8]. Gonzalez-Espinosa S examined how teaching strategies and student gender affected basketball learning disparities [9]. Rana M mentioned that the kinematics analysis of wearable sensors could provide athletes with real-time feedback about the technologies they use in their own sports, thus helping them to compete efficiently [10]. Pustisek M introduced the characteristics and limitations of various sensors used for sports activity signal acquisition, communication methods and communication channels [11]. Girma M G thought that Physical Education (PE) teachers had enough technical ability to teach basketball practice lessons [12]. The use of multi-information data fusion technology in research has been steadily growing in recent years, but little is known about how it might be combined with teaching basketball to college students. It is vital to do application study on multiinformation data fusion in college public sports basketball instruction in order to represent the impact of this technology on the current teaching mode.

This paper studied the application of multi information data fusion in college public sports basketball teaching. Through the global positioning system and remote sensing technology, student basketball sport was monitored, and the controlled experiment and questionnaire survey were

conducted. The experimental data and questionnaire survey results showed that the data recorded by remote sensing technology for four basketball players could correspond to the results recorded by three student representatives taking the majority, which fully demonstrated the accuracy and authenticity of remote sensing technology. The GPS micro system measured that the average speed of No. 3 athlete was the fastest, which was 9.1 meters per second; the average speed of No. 4 athlete was the slowest, which was 7.85 m/s; the heart rate of No. 4 occurred 182 times/minute in 4 minutes and 166 times/minute in 5 minutes, which exceeded the normal heart rate. The results of the second interest survey showed that the number of people interested in college basketball classes increased by 3. Those who were not very interested dropped to zero, while those who were highly interested rose by twenty-five. It was evident that multi-information data fusion technology might help students reach their full sporting potential and capitalize on their technical basketball advantages. This could raise students' basketball skill level and clearly support college basketball instruction.

2. Evaluation of College Public Sports Basketball Teaching

2.1. Overview of College Public Sports Basketball Teaching

Socialist sports with Chinese characteristics are an important part of the construction of socialism with Chinese characteristics and play an active role in the overall construction of a moderately prosperous society. Public physical education in colleges and universities is the main way for students to exercise. Through appropriate scientific education and sports, the goal of improving physical fitness and health can be achieved. The traditional physical education curriculum attaches importance to “teacher teaching”, but it belittles “student learning”. The teaching purpose is only to complete the teaching task [13].

As an important part of college education, physical education in colleges and universities has a dual responsibility to cultivate all-round and innovative talents. With the rapid development of basketball in the world, basketball culture has been widely spread in colleges and universities. Some new cultural ideas about basketball in the field of campus sports have become cultural types that cannot be ignored or lacked. For quite a long time, by drawing on the educational and heritage scholarships, as well as the theoretical framework of sports cultural space, the academic community has been working with the cultural and artistic departments to achieve a win-win situation in terms of knowledge, economy and pragmatism [14]. This has put forward higher requirements and more arduous challenges for college public sports basketball teaching. The outdated teaching concept and method and insufficient investment in teaching facilities are the problems existing in the public sports basketball teaching curriculum in colleges and universities today. The traditional “spoon feeding” teaching method can not thoroughly implement the concept of quality education. The so-called teaching reform is just a formal reform, which does not really understand the connotation of quality education, so teaching can not really give play to the subjective initiative of students. The introduction of multi-information data fusion technology into public basketball classes at colleges and universities aims to raise student dominance and foster the growth of high-quality education while also improving the teaching style and developing a variety of basketball skills.

2.2. Multi Information Data Fusion Technology

Multi information data fusion is a multi-level and multi-level process, including testing relevance, composing and configuring multi-source data, so as to improve the accuracy of test status and identity, and comprehensively and timely assess the importance of battlefield situation and threats. The multi information data fusion technology is shown in Figure 1.

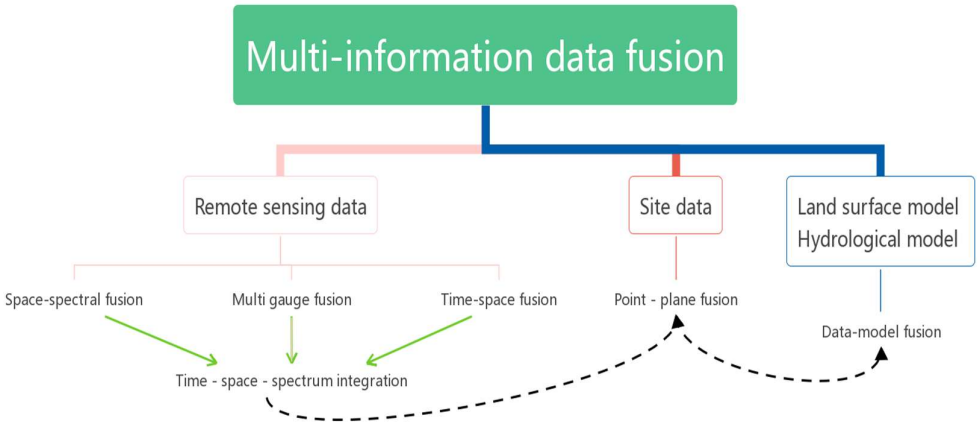


Fig. 1. Multi-information data fusion technology diagram

Due to the advantages of information processing, data fusion technology has attracted more and more people's attention and application. The general architecture of data fusion is classified according to the location of fusion and the transmission mode of data stream.

1) Centralized fusion structure. The centralized fusion structure transfers the original data from multiple sensors to a central merge processing device, which combines feature extraction, data connection and fusion computing. Theoretically, this combined structure is the best, because it can achieve integration in a fairly accurate time and space, as shown in Figure 2.

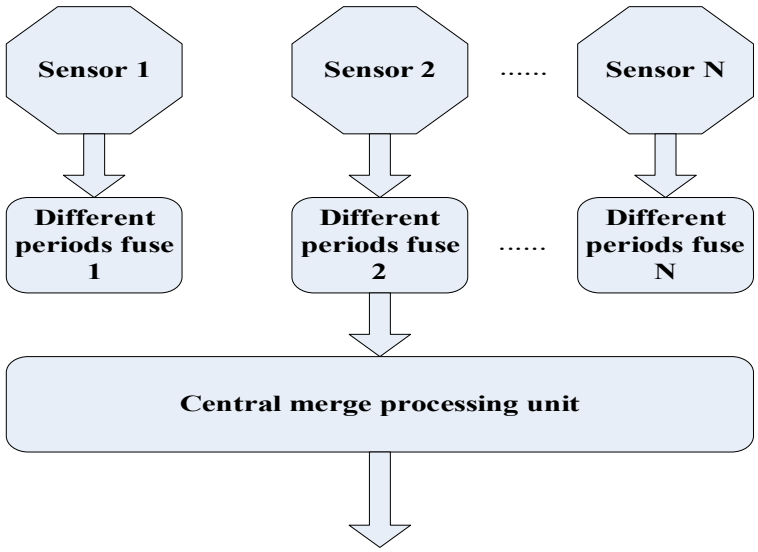


Fig. 2. Centralized fusion structure

2) Distributed fusion architecture. Distributed fusion structure refers to that there are multi-level fusion nodes under the central consolidation processing device, and each fusion node can perform data calculation and transfer the results to the next node. This method can effectively reduce the amount of communication data and distribute the calculation cost to each node, as shown in Figure 3.

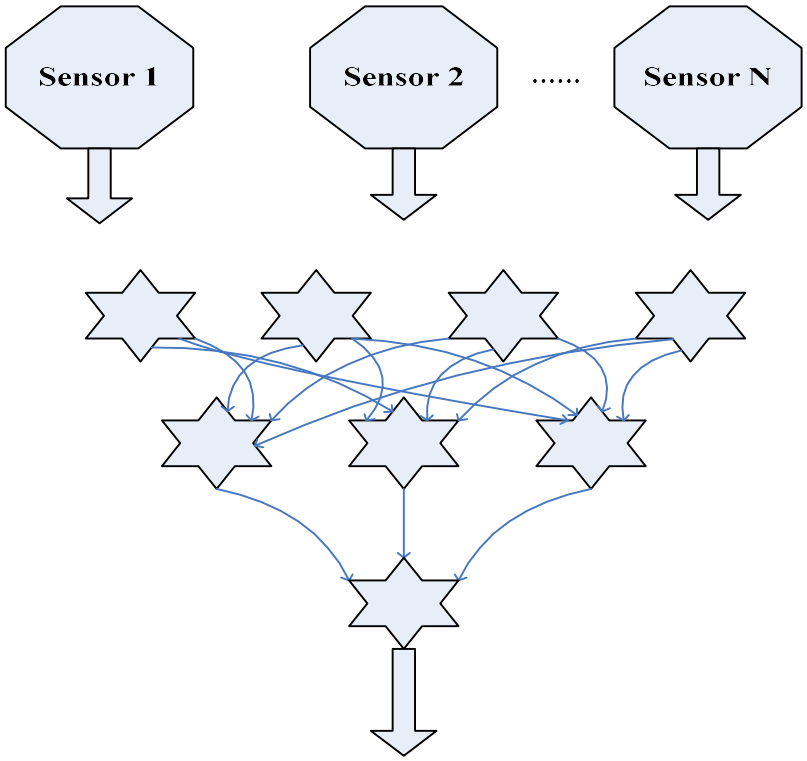


Fig. 3. Distributed fusion architecture

3) Hybrid fusion structure. This structural pattern is a combination of the above two patterns. The fusion node performs distributed computing, and then transmits the results at all levels to the central consolidation processing device for fusion computing. The purpose is to distribute the small amount of data computing cost on the nodes, and concentrate the main fusion data computing cost on the central consolidation processing device, as shown in Figure 4.

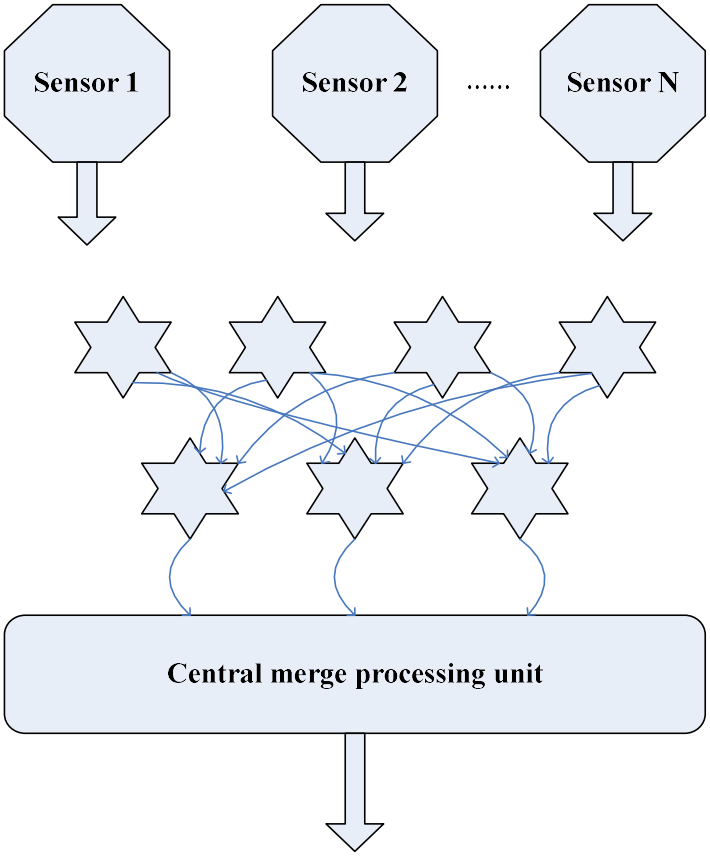


Fig. 4. Hybrid fusion structure

The process and algorithm of multi information data fusion are evaluated. It is assumed that the data of two sensors are correlated and fused. Sensor 1 has M pieces of data and sensor 2 has N pieces of data, which form $M \times N$ possible data correlation pairs. It is assumed that there are T_n valid data pairs from the same target, T_1 of which are correctly determined to be relevant after correlation processing, and T_2 of which are incorrectly determined to be irrelevant; $T_n = T_1 + T_2$; there are T_k valid data pairs from different targets; T_3 are correctly determined as irrelevant after relevant treatment; T_4 are judged as relevant by mistake; $T_k = T_3 + T_4$; $M \times N = T_n + T_k$.

(1) Correct correlation probability P1. The probability that valid data pairs from the same target are correctly determined to be relevant is as follows:

$$P1 = \lim_{Tn \to +\infty} (T1 / Tn) \tag{1}$$

(2) Error uncorrelation probability P2. The probability that valid data from the same target are incorrectly determined as irrelevant is as follows:

$$P2 = \lim_{Tn \to +\infty} (T2 / Tn) \tag{2}$$

(3) Probability of correct separation P3. The probability that valid data from different targets are correctly determined as irrelevant is as follows:

$$P3 = \lim_{Tk \to +\infty} (T3 / Tk) \tag{3}$$

(4) Error correlation probability P4. The probability that valid data from different targets are judged as relevant to errors is as follows:

$$P4 = \lim_{Tk \to +\infty} (T4 / Tk) \tag{4}$$

(5) Comprehensive correlation probability of data P0. The probability of correct determination of any possible data correlation pair is as follows:

$$P0 = \lim_{Tn,\ Tk \to +\infty} \left[P1\left(\frac{Tn}{Tn+Tk}\right) + P3\left(\frac{Tk}{Tn+Tk}\right) \right] \tag{5}$$

Multi information data fusion methods include many kinds. This paper studies the impact of remote sensing technology and GPS positioning system on college public sports basketball teaching.

2.3. Remote Sensing Technology

Remote sensing technology is a powerful means to collect and update spatial data, which provides high real-time accuracy, extensive monitoring, and all-round positioning. Big data has attracted increasing attention due to its huge amount of information and complexity, and has been developed and applied in all walks of life [15]. Remote sensing technology is one of the sources of big data. The data of big data is shown in Figure 5, and the remote sensing technology system is shown in Figure 6.

Fig. 5 Big data contains graphs

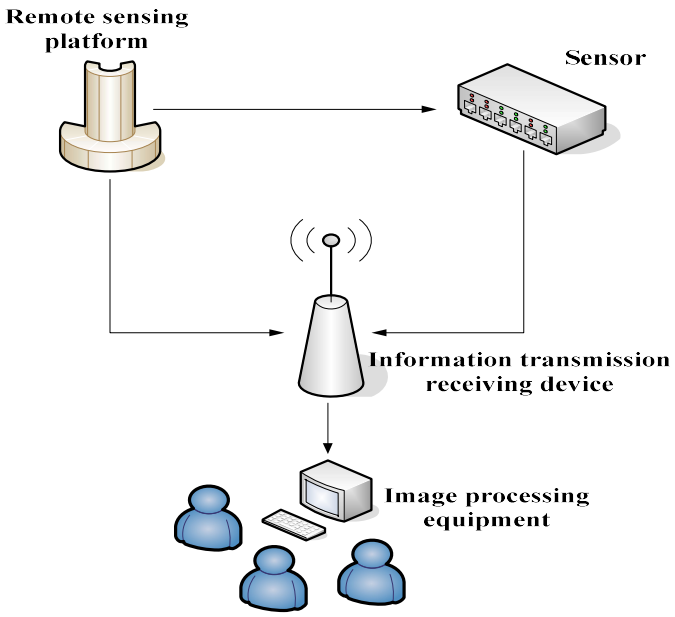


Fig. 6. Remote sensing technology system

2.4. Global Positioning System

GPS is one of the fastest, most convenient and more accurate methods to obtain the current coordinates. According to the vector data provided by the current baseline map, the latest data can be found by matching the real-time results of GPS data. The principle model of satellite positioning is shown in Figure 7, and the display principle of satellite positioning system is shown in Figure 8.

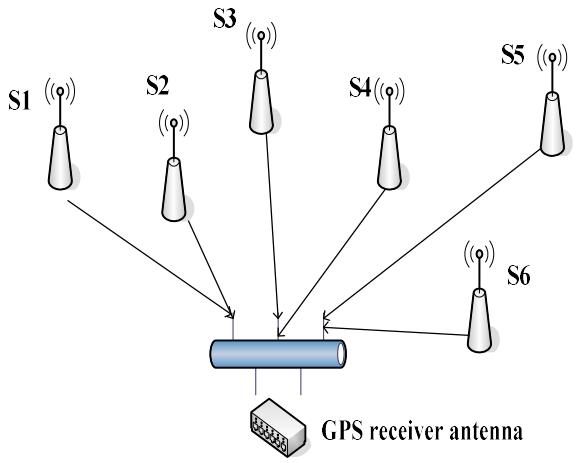


Fig. 7. Satellite positioning principle model

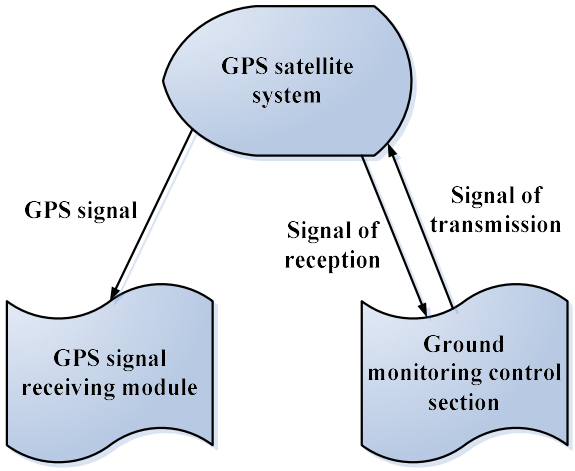


Fig. 8. Display principle of satellite positioning system

3. Experimental Evaluation of Basketball Teaching of Public Sports in Colleges and Universities

3.1. Application of Remote Sensing Technology in College Public Sports Basketball Teaching

In order to reflect the impact of remote sensing technology on college public sports basketball teaching, this paper selects 4 students from Class A of a college physical education institute to conduct a comparative experiment. Remote sensing technology can effectively capture the number of times students pass and touch the ball when playing basketball through the real-time performance of data sensors, and analyze the data to obtain the success rate of students' passing and scoring rate of throwing. Therefore, remote sensing technology is used to carry out relevant experiments. The four students are asked to play a 2V2 basketball game, and the students are divided into two teams: red team and blue team. The two members of the red team are coded as 01 and 02; the codes of two

members of the blue team are 03 and 04; the remote sensing technology is used to count the number of passes and touches of the four students in the basketball match, and three student representatives are selected in Class A to manually record the number of passes and touches of the four students. Finally, their pass success rate and throw scoring rate are calculated respectively. The data obtained by manual recording is compared with the data measured by remote sensing technology, as shown in Table 1.

Table 1. Comparison table between manual recorded data and remote sensing data

	Athlete Code	Items	Student representative1	Student representative2	Student representative3	Remote sensing technology
The Red Team	01	Number of touches	10	9	10	10
		Pitch score rate	75%	33.3%	33.3%	75%
		Number of passes	6	6	7	6
		Success rate of passing	60%	60%	65%	60%
	02	Number of touches	12	12	13	12
		Pitch score rate	50%	50%	60%	50%
		Number of passes	8	8	7	8
		Success rate of passing	20%	20%	30%	20%
The Blue Team	03	Number of touches	8	8	8	8
		Pitch score rate	50%	50%	50%	50%
		Number of passes	4	4	4	4
		Success rate of passing	50%	50%	50%	50%
	04	Number of touches	15	13	13	13
		Pitch score rate	20%	50%	50%	33.3%
		Number of passes	10	11	11	10
		Success rate of passing	50%	60%	60%	50%

The data in Table 1 shows that the data of the three student representatives are consistent only when recording the situation of the No. 3 athlete of the blue team, but there are data deviations when recording the other three members. When the three student representatives record the sports of basketball players, if the data are inconsistent, they adopt the principle that the minority is subordinate to the majority. The data of two members whose records are consistent are obtained. It can be found from the data that the data recorded by remote sensing technology for four basketball players can be corresponding to the results recorded by three student representatives taking the majority.

3.2. Application of Global Positioning System in College Public Sports Basketball Teaching

In order to reflect the influence of GPS system on college public sports basketball teaching, a miniature GPS system is installed for four basketball players during basketball matches. The front of the system is also attached with a heart rate band, which is used to count the running distance, average speed and heart rate of the four members during exercise. Figure 9 shows the statistics of running distance of basketball players.

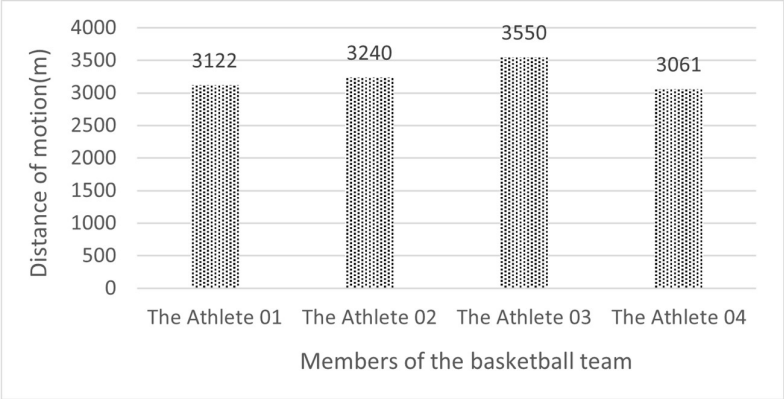


Fig. 9. Statistical graph of distance run by basketball players

The distance of four athletes can be obtained from Figure 9. In addition, the duration of this 2V2 basketball game is 6 minutes and a half, that is, it takes 390 seconds. The average movement speed of basketball players is obtained by combining their movement distance, as shown in Figure 10.

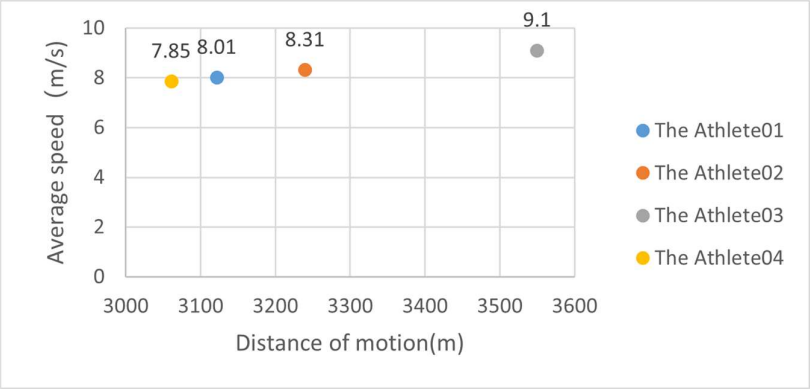
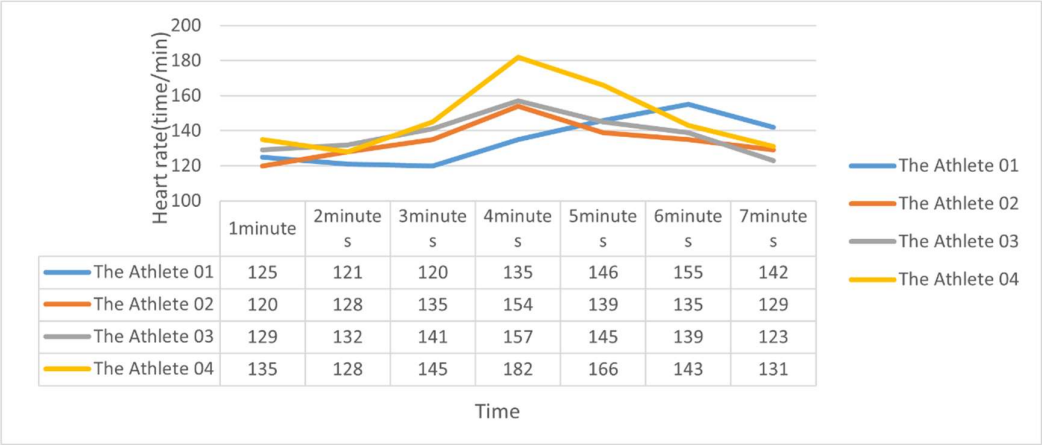


Fig. 10. The average motion rate of basketball player

It can be seen from Figure 10 and Table 1 that the average speed of No. 3 athlete is the fastest, which is 9.1 m/s; the basketball skills of the third member are relatively stable. Whether the passing rate or the shooting rate, he maintains at 50%, which indicates that the No. 3 athlete should continue specialized technical training to ensure a breakthrough in technology in the future; the average speed of No. 4 athlete is the slowest, which is 7.85 m/s. The passing success rate of No. 4 athlete is also 50%, and the shooting rate is only 33.3%. Besides, the movement speed of No. 4 athlete is relatively slow. Thereafter, more efforts can be made in speed training and shooting training.

The normal human heart rate is 120-160 beats/minute. It can be seen from Figure 11 that the heart rate of No. 4 occurs 182 times/minute in 4 minutes and 166 times/minute in 5 minutes. These two times exceed the speed of normal heart rate. The previous analysis find that the movement speed of No. 4 is the slowest, indicating that No. 4 lacks exercise to cause poor blood circulation. He should increase exercise appropriately step by step, and strengthen his resistance.



	1minute	2minutes	3minutes	4minutes	5minutes	6minutes	7minutes
The Athlete 01	125	121	120	135	146	155	142
The Athlete 02	120	128	135	154	139	135	129
The Athlete 03	129	132	141	157	145	139	123
The Athlete 04	135	128	145	182	166	143	131

Fig. 11. Heart rate graph of four basketball players

3.3. Questionnaire

56 students from the Institute of Physical Education's Class A are the subject of this study, which uses a questionnaire. There are 55 pupils and one PE teacher among them. Two surveys are administered in Class A of the experiment before and after the introduction of multi-information data fusion

technology in order to guarantee the validity and reliability of the questionnaire. In order to fully and accurately reflect the changes in students' attitudes following the implementation of multi-information data fusion technology in the sports basketball class, the survey's content focuses on the level of interest that both teachers and students have in the class.

1) Questionnaire reliability. This survey distributes 56 questionnaires in total, 56 of which are recovered, yielding a 100% recovery rate. No questionnaire has a lot of missing questions or is incorrect. The Clonebach coefficient, or α, is chosen as the reliability coefficient after the questionnaire results are examined using SPSS software. According to Table 2, the two questionnaires' clonal bach coefficients (α) are 0.89 and 0.92, respectively, both of which are higher than 0.85, suggesting that the questionnaire used in this study has strong reliability.

Table 2. Reliability test table of survey data

	Number of options	Cronbach's Alpha
The first questionnaire	4	0.89
The second questionnaire	4	0.92

2) Questionnaire results. This research investigates the degree of interest of the teachers and students of Class A in the sports basketball class. The survey results are shown in Figure 12.

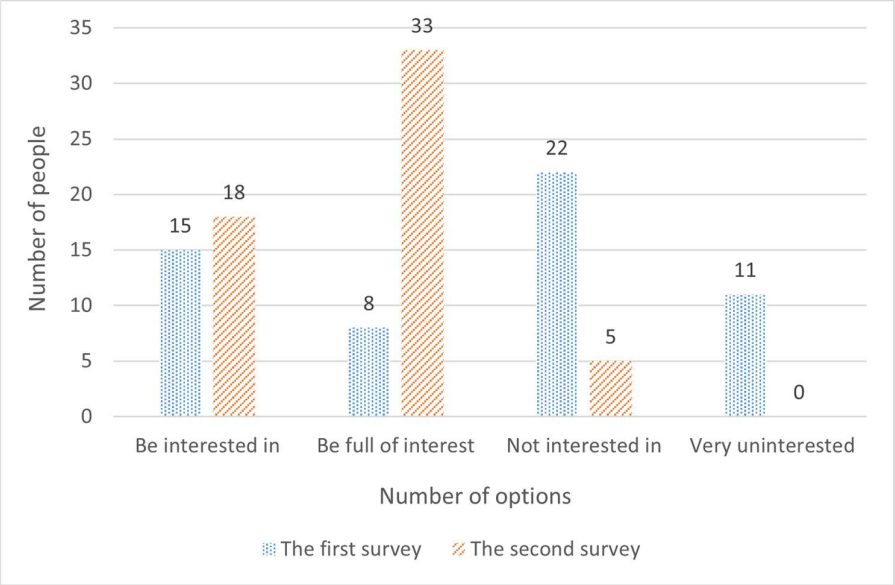


Fig. 12. Comparison of interest between the two surveys

According to the results of the second survey, there are now three more persons interested in taking a college basketball course, and there are twenty-five more people who are extremely interested. There are zero less persons who are not particularly interested. This indicates that students' interest in teaching basketball has increased dramatically since the introduction of multiinformation fusion technology into college sports basketball classes. This has helped to increase students' enthusiasm for basketball lessons and enhance the classroom environment. The greatest teacher is interest, and as it grows, so will pupils' attitudes and affection.

This experimental group's brief use of GPS and remote sensing technology revealed that multiinformation fusion technology can assist teachers in quickly identifying students' strengths and weaknesses in addition to analyzing basketball game data. In order to reinforce the system, rectify its flaws, and accentuate its benefits, it can even show the physical state of the pupils. In a similar vein, teachers may use the precise and useful data that multiinformation fusion technology provides to direct their basketball lessons and create customized training plans based on the unique needs of

each student.

4. Conclusions

The application of multi information data fusion in college public sports basketball teaching is of great significance. It could be seen from the experimental data that the multi information data fusion technology of GPS positioning system and remote sensing technology was an important and inevitable trend to integrate into the future college public sports basketball teaching curriculum. Multi information data fusion technology could improve the level of basketball teaching and make up for the shortcomings of traditional basketball teaching, which made contributions to students' setting more standard and reliable sports basketball classes. The research data proved that the multi information data fusion technology could mobilize the students' subjective initiative and enthusiasm in basketball class, and had obvious advantages in improving the teaching atmosphere of sports basketball. It is undeniable that the multi information data fusion technology college sports basketball teaching is further towards the concrete construction direction.

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