Tactical Analysis of Serve Attack and Defense in Volleyball Training Based on Decision Tree Algorithm

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ABSTRACT: *This article mainly explores the tactical analysis of the attack and defense stages of volleyball training based on a decision tree algorithm. By constructing a decision tree model, various tactics in the attack and defense stages of serve are classified and predicted, providing more effective training suggestions and guidance for coaches and athletes. Taking a volleyball team as an example, this model was used to analyze the training data of its serve attack and defense links. By constructing a decision tree model, it was found that the team had some problems in the attack and defense stages of serving, such as the need to improve the serving speed and accuracy, and the need to improve the reaction speed and judgment ability when receiving the serve. In response to these issues, the model provides corresponding training suggestions and guidance, providing strong support for the team to further improve the level of serve attack and defense.*

Keywords: Decision Tree Algorithm, The Application of Tactics, Serve Tactics

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1. Introduction

In a volleyball match, how the volleyball players combine their own excellent tactical awareness with their own technical level in a reasonable way, is a great help to win the final victory of the volleyball match, and is the fundamental guarantee of victory [1]. The tactical awareness of volleyball means that the athletes give full play to the subjective initiative in the competition to improve their own comprehensive ability. The tactical consciousness of volleyball is the reaction of the objective law of volleyball in the human brain, and is the full combination of athletes' theory and practice of volleyball tactical knowledge [2]. For that reason, the tactical awareness of volleyball should be carried out through practical activities such as perception, imitation and application, so it is necessary to carry out technical training and tactical training, which make the brain form effective storage and processing in a regular game and reflexively release at a necessary moment. And the training of the athletes'

psychological quality is also an important part of tactical awareness, which requires the athletes to pay more attention to the imperceptible effect of psychology in training tactical awareness [3]. After recognizing the importance of tactical awareness, how to effectively train the tactical awareness of volleyball teaching in the volleyball match has become an urgent problem for today's volleyball coaches.

2. State of the Art

Society is developing, and the times are progressing; in today's world volleyball field, Whether the European and American volleyball teams with high and fast combinations or the Asian volleyball team that focus on fast change, they all take serving a ball as the key to the success of the tactics [4]. Especially in the competition among the Asian European and American teams, the consequence of the competition is generally decided by the antagonism effect of competing service tactics [5]. How to improve the attack of serve is an everlasting topic in the world volleyball field because the serve is no longer only understood as the beginning of the game; it's the beginning of the attack and the beginning of a tactical offensive; it can be interpreted as the "first attack" of the game, driving the block with serve, promoting the organization and implementation of anti-counter tactics, and raising the serve to a new tactical position. Because the possibility of the serve side's score of the ball is less than the return of the service side, it is necessary to carry out a targeted attack on the serve to improve the efficiency of scoring [6]. Looking at the status of China in the volleyball league, the practice of "compete" on the serve is far lower than the world's advanced level, and most teams' offensive of serve is far from the expected effect of the tactics, there still is a very large gap to achieve the ideal effect of tactical breakthrough. How to effectively solve the contradiction between the serve and the Rally Point System and successfully use the competing service tactics in actual combat is an important pass for our volleyball team to break through in the serve training [7].

3. Methodology

3.1. Decision Tree Algorithm

The decision tree algorithm is mainly used for the classification and prediction of data, and it is one of the most widely used data mining algorithms at present. It starts traversing from the root node and selects one branch in the search process by using the inductive algorithm until the selection of a leaf node, thus creating a decision tree. In the decision tree, in order to realize the classification of data, in accordance with the classification rule of IF-THEN, the decision tree into multiple classification rules from the root node to the leaf node. The advantage of the decision tree algorithm is that the model is simple and has strong robustness, the accuracy of the classification is high and the speed is fast. There are a variety of decision tree algorithms, and the ID3 decision tree algorithm is the most widely used.

Construction of ID3 decision tree algorithm: the ID3 decision tree algorithm uses the information gain as a test attribute to select a branch node, first to set the node with the highest information gain as the root node of the decision tree, and then to find secondary high node as the branch of the decision, and the like, finally a simple decision tree is generated through recursion.

Set entropy of information. Suppose that the training set S contains Si (where i =1, 2,... m) data samples, and it is divided into m classes $c1, c2,... ci$ (of which i =1, 2,... m).

$$l(S_1, S_2, ... S_m) = -\sum_{i=1}^{m} P_i \log_2 P_i \quad (1)$$

In the formula: because the information is binary coded, so the function used is logarithm with 2 as the bottom; Pi represents the probability of a random data sample belonging to class ci in training set S, and Pi is estimated by SiS.

Select the root node. Set the attribute A as the root node of the tree, and the A contains v values $\{a1, a2,..., av\}$. The training set S is divided into subsets $\{S1, S2,... Sv\}$, set the value of A as aj, and a subset is Sj. Sij is the number of samples in the Sj that belong to the Ci, then:

$$E(A) = \sum_{j=1}^{V} \frac{S_{1j} + S_{2j} + ... + S_{mj}}{S} l(S_{1j}, S_{2j}, ... S_{mj}) \quad (2)$$

In the formula: $\frac{S_{1j} + S_{2j} + \ldots\ldots + S_{mj}}{S}$ is the weight of the subset *Sj*, the information entropy of the set *S* is derived by using the formula (2):

$$l(S_{1j}, S_{2j}, \ldots\ldots, S_{mj}) = -\sum_{i=1}^{m} P_{ij} \log_2 P_{ij} \tag{3}$$

In the formula: $S_{ij}\, l \,|\, Sj \,|$ is used to estimate *pij*, which represents the probability of a random data sample in a subset *Sj* belonging to the class *Ci*. The information gain of the branch *A* is as follows:

$$Gain(A) = l(S_1, S_2, L, S_m) - E(A) \tag{4}$$

Information gain is used to describe the purity of the sample subset, and the greater the information gain is, the purer the subset of partitioned samples is, which is more conducive to the optimization and classification of sets.

Performance analysis of ID3 decision tree algorithm. ID3 decision tree algorithm starts from the empty tree, using the hill-climbing strategy to traverse hypothesis space to deal with large-scale data sets; its advantages and disadvantages are as follows: The advantages: ID3 decision tree algorithm uses hill-climbing strategy to traverse the search space, if the category information attributes is non-discrete, in order to reduce the sensitivity of the training samples, it is necessary to do information discretisation for the category information. Shortcomings: because the decision-making method starts from the root node to traverse the whole decision tree, so its generality is very weak. When splitting nodes are selected, we need to calculate the information entropy of each attribute to determine its splitting property; the amount of calculation is large; if there are lots of attributes, it will increase the cost of the decision tree, and at the same time, the efficiency of operation will also be greatly affected.

3.2. Analysis of the Important Role of Volleyball Competing Service Tactics

We are successfully restraining the attack system of return of service. Suppose the competing service tactics can be well used. In that case, a restraining way to fight against the opponent's return of service system can be formed in a very short period, and it can quickly break the balance of attack and defense with the opponent to take the initiative in the competition. According to the effective principle of the law of gain and loss, we need to be "less lose and more gain" in the game; the proportion of the attack system of the return of service in the volleyball match is very high.

Successfully reverse the passive situation of anti - counter system. In the contest with the opponent's return of service system, competing service can create a very favorable anti - counter condition for us, so it can be easier for us to take the initiative in the game. In other words, we can use the serve as a powerful means of attack, using the high speed and powerful advantage of the jump-serving to win the score, and it can effectively reduce the pressure of the team's blocking and prevention system. Even if it doesn't work, we can again try to respond to the opponent's attack by an anti-counter system.

Making trouble for the opponent' attack on the return of service. If our attack system of the return of service is relatively stable, the failure rate of serve is also generally higher, and therefore, we can use the competing service strategy to attack the opponent's attack system of the return of service, which will greatly improve the possibility of our victory

3.3. Tactics Application Strategy of Competing Service in Volleyball Match

Ensure the efficiency of the service speed. As is known to all, the high quality of the service has led to a reduction of the unit rate of competing services from 75% to 55% at the present stage; it declined by about 20%, which has a huge impact on the first attack system of a volleyball match. In recent years, through the practice of various world-class competitions and scientific statistics, in the services of the winning team, nearly 10% can get a direct score and more than 20% break the attack, which is nearly 1 times higher than the previous serve. These data are sufficient to prove the great power of the competing services.

Combine the practice and determine the application strategy of the competing service. Usually, in the first round of anti-counter, to bring enough pressure and influence to the opponent's return of serve, the teams will first use competing service tactics. The key point of the rational use of competing service tactics is to correctly understand and accurately grasp the "less lose and more gain", according to the real serve level of the team and the specific circumstances of opponent team

players to weigh in. In the process of actual combat, the athletes must adhere to two basic principles, one is the principle, and the other is the feeling. Specifically, it is to respect the inherent rules of competing service, and at the same time, to respect own true feelings, when the feeling is uncomfortable or uncoordinated, do not force yourself to compete, otherwise, the result is often invalid. The specific application strategy is mainly concentrated in the following 10 aspects.

If the service cannot be guaranteed to reach the standard speed, it should be considered that, do not to use the technique of jump-serving in the game as much as possible. When making a competing service strategy, do not make blind and hasty progress, it must be based on the technical expertise of each athlete and the actual situation of the opponent, and it will be determined after a comprehensive examination and comparison if the serve is accurate, then to find the placement, when the speed of serve is good, then compete with speed. f it is in a real battle, the goes point for point shows a state of glue, and then can try to break this stalemate through the tactics of a spelling. If our score is ahead, to continue to widen the gap and strive for better results, the competing service strategy should be adopted. If the opponent's score is ahead, to shorten the gap and turn the tide, the competing service must be adopted to save the game. If the opponent uses competing service when do the first attack, it's time to seize the opportunity, break the first pass through competing service, and change the state of the opponent's strong round into a weak round. When the opponent's first attack is in the state of a weak round, keep serving, strain every nerve to reduce the failure of serve, through our anti-counter strong round to thoroughly seize the opponent's weak round. In an opponent makes continuous mistakes and in a chaotic situation, we need to keep service and prevent mistakes, no chance to leave the opponent to breathe. When the opponent first reaches the match point, compete service, because now if we serve simply is equal to giving points to the opponent. If we first reach the match point, keep service, because this will give the opponent a lot of pressure, the first attack of the opponent will be affected mentally, and it also avoids our mistake and gives the opponent score.

Attach great importance to the placement of the competing service and spare no effort to improve the skill of the competing service. As a professional volleyball athlete, when in the face of the backwardness of the service speed, it is necessary to make the best use of the advantages and bypass the disadvantages. Scientifically selecting serve point and placement to disturb the opponent's judgment. Choosing the placement of service cautiously to reduce the attack points of the opponent. Adhere to the principle of bullying the weak and fear the strong. This principle is widely used in volleyball, which refers explicitly to finding out the worst athletes or the athletes who drop off form in the opponent's dig and attack them. Even if the serve is good, the opponent digs steadily, and the score cannot be got. Therefore, we should avoid attacking strong by strong, preserve strength and look for the opponent's weakness carefully, use strong to attack weak, choose the opponent's serving objects purposefully, and use the method of "bully the weak and fear the strong" to win.

Work hard on the order of the serving players. In every volleyball team, the level and ability of the athletes are different, and the arrangement of the order of serve is likely to be the key to success. In a volleyball match, the times of serve of every player in a bureau are 3-4 times average, the order of the player's serve is determined according to the position table submitted before the start of each game. Therefore, we have to work hard on the order of serving, to have a more accurate grasp of the rules of the serve and make the most reasonable and effective arrangements for the order of serve, correctly maximize the use of all the players in the game.

4. Result Analysis and Discussiona

4.1. Attack Mode of Second Pass in No. 1 Position

When the second pass is in the number 1 position, its return of serve formation is shown as figure 1, this round is called the "counter round" of volleyball attack, that is: because the supply round transferred to no.4 position in the front row, no.2 position's main attack initiatively retreats to do return of serve, the form of attack is shown as figure 1, in the face of this attack mode, the tactics serves of attacking in the strong limit are: one is to contain the main attack of the front row, control the placement of the serve near the main attack of the front row, which not only can disturb the running of the second pass, but also effectively interfere with the attack rhythm of the main attack, and compel the opponent's attack point to gather between 3 and 4, reduce blocking network segments, and reduce the pressure of anti-blocking; the other is to limit the back line of attack of the supply, control the placement of the serve at the back of the supply, it can limit the main attack at the back row to do return of serve and can disturb the back line of the supply, compel the opponent's attack point to gather between 2 and 3, it can also reduce the pressure of anti-blocking. In the four games in the final and semifinals, when the second pass is in the no.1 position, the service statistics of the attacks for front and rear main attacks is like table 1, it's not hard to see from table 1 that, when the second pass is in the no.1 position, while each team is serving, the tactical attacks for front and rear main

attacks are all over 75%, in particular, Serbia is up to 86.11%, carry out chi-square test on the probability of attack front and rear main attacks, p values are less than 0.01, which have significant differences, therefore, in this serve of return of serve offence line-up, restraining the main attack's attack point of the front row is mostly adopted to reach the tactical effect.

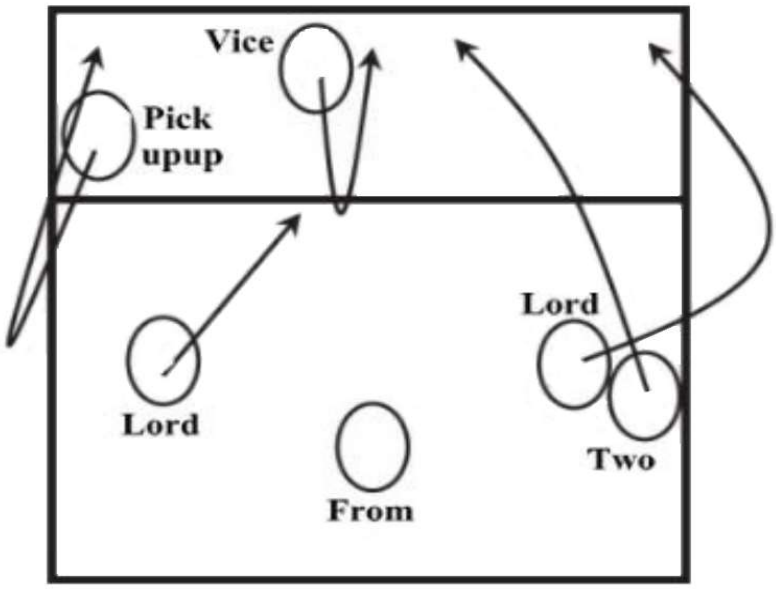

Figure 1. The second pass in the first bit when the ball-type configuration map

Target and probability	Main attack in the front row	probability (%)	Main attack in the back row	probability (%)	P
China	27	84.36	5	15.64	<0.01
Serbia	31	86.11	5	13.89	<0.01
America	25	78.13	7	21.86	<0.01
Netherlands	29	76.32	9	23.68	<0.01

Table 1. The Statistics of the Pertinence of Serve

4.2. Attack Mode of Second Pass not in no.1 Position

When the second pass is not in the number 1 position, the main attack in the front row always retreats to the left side of the course; at the same time of the service of the return of serve, it is convenient to strongly attack no 4 position, and the supply strongly attack no.2 position in the front row or no.2 position in the back row when in the condition of do not receive, the assistant attacker also contain the middle part, the main attack in the back row attack no.3 position in the back row according to the position, as shown in figure 2. Facing this mode of attack, when the supply is at the front row, because of the concealment of the running route, retraining the main attack in the front row is mostly adopted, disturbing the offensive tempo of the no.4 position and compelling the opponent's attack point to gather between 2 and 3. In four games, the probability of the supply at the front row serve for the attacker is as shown in table 2 we can see that when the supply is at the front row, the serve that is aimed at attackers is reflected in the main attack, the probability is over 70%, this is due to the concealment of the running route of the supply at the front row. Therefore, in the tactical serves that are aimed at the main attack, according to the condition of the first pass, pay more attention to block supply's attack. When the supply is at the back row, if the main attack in the front row has strong ability, then restrict the main attack in the front row; if the supply's ability to attack is strong, it is

able to effectively disturb the running route of the supply to reduce the attack possibility of supply in the no.2 at the back, to compel the opponent's attack point to gather between 3 and 4. In Table 3, we can see that when the supply is at the back row, because the running route is in the in the course, the possibility of disturbing serve in serving increases; in the serve of Serbia, the serve for supply is almost up to 50%, this is also related to that in its match with China, Zhang changing served as a return of serve. But we can't deny it from the table, in the comparison of table 2 and table 3, when the supply is in the back row, the serves for supply increase obviously.

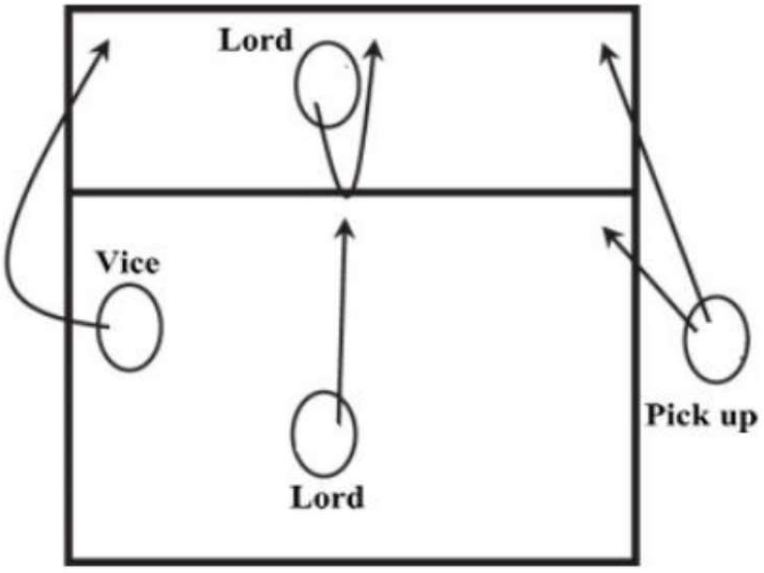

Figure 2. Second pass when the ball is not in the first position figure

Group	Main attack	possibility (%)	supply	possibility (%)	assistant attacker	possibility (%)
China	39	82.98	5	10.84	3	6.38
Serbia	42	75.00	12	21.43	2	3.57
America	41	73.21	9	16.07	6	10.72
Netherlands	35	76.09	6	13.04	5	10.87

Table 2. The Statistics of Serves for Attackers when the Supply is at the Front Row

5. Conclusion

Today's volleyball is not only is the battle of technology, tactics, physical fitness, and will quality, it is the contest between personal tactical awareness and overall tactical awareness, to master the basic tactical awareness of volleyball in order to fight against the opponent in a fierce competition. The training of the tactical consciousness of volleyball is an important part of the volleyball training, improving the tactical awareness of volleyball is one of the most important ways to improve the level of volleyball. The application of tactics in volleyball training based on a decision tree algorithm is researched and analyzed. Volleyball's serve is the first attack of the match, the embodiment of its aggression is not only in speed and strength but in tactics; that is, in the condition of reducing speed and strength, the pertinence of serve can be used to limit the opponent's attack tactics and reach the tactical goal. The tactics of the volleyball serve are mainly reflected in the pertinence of the serve, mainly in the pertinence of strong attack points quick attack points; in the match, the pertinence of the serve is more directly reflected in the attack on the opponent's strong attack points, indirectly attack the opponent's quick attack and

customary tactics. To improve the aggression of the serve, not only improve the speed and strength of the serve but also ensure the stability of the serve, reasonably grasp the relationship between "aggressiveness and strategy" and weigh the advantages and disadvantages of making serve tactics.

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