

“Eagle Eye”--Application Analysis of Instant Playback System to Tennis Match

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ABSTRACT. *Hawkeye is also called “instant playback system”. Hawkeye-instant playback system is a computer system used in other sports fields, such as tennis and badminton, to display and record the actual trajectory of graphic images and the path of the ball, and to predict the future movement trajectory of tennis. The significance of the “eagle eye” system is to help the judges make accurate and fair decisions by overcoming the defects of human observation ability, such as the limitations of dynamic visual acuity.*

KEYWORDS: *Eagle eye; Tennis.*

1. Introduction

There is a sport whose origin can be traced back to the 12th-13th century. France was the beginning of its birth, Britain was the place where it was born, the United States was the place where it was popularized, and finally it became popular all over the world. This sport is tennis. At present, tennis is already one of the most popular sports in the world. The development of tennis can be described as changing with each passing day. Even though the fierce collision between the players and the net does not leave any disadvantage, it also indirectly promotes the straight-line improvement of players' techniques and tactics and the gradual specialization of the audience. However, problems are springing up like bamboo shoots after a spring rain. One of the reasons is that the technical level of tennis is improving day by day, the difficulty of penalty is increasing exponentially, and the problem of penalty errors is also increasing gradually. Disputes between referees and athletes due to different opinions are more and more frequent in tennis matches. Following the trend of the times, eagle eye technology was born. Sports competition is turned upside down by this new outsider, “eagle eye” changes sports competition from the hot eye of human beings to the cold eye of machines. No matter who it is, Eagle Eye technology has injected new elements into sports competition. It can make the audience watch the live broadcast of the competition more intuitive, clear and understandable, and provide important basis for the competition. It can record the whole competition process, and then process the recorded pictures through a series

of calculation principles, so that the pictures can be slowed down according to a certain number of frames to deal with errors and errors in judgment and prevent the formation of competition disputes. At present, the upsurge of “Eagle Eye” has not cooled down. Therefore, creator Hawkins said that the meaning of “Eagle Eye” is to help judges make accurate and fair decisions by overcoming the defects in human observation ability, such as the limitations of dynamic visual acuity. This is not only a good original intention, but also a heavy responsibility.

2. Eagle Eye-A Brief Overview of Instant Playback System

Research Status of Short Tennis

Hawkeye was created by Paul Hawkins of England. The first four letter combinations of his surname have made “Eagle Eye” a famous and familiar title. Hawkeye technology is a complete set of mechanical equipment used in sports such as tennis. It can track the trajectory of tennis flight, display the actual trajectory of graphic images, and predict the future trajectory of the ball flight. “Hawk-Eye” technology has become an indispensable part of the referee's decision-making process in tennis competitions. What few people know is that in the first three years of “Eagle Eye”, it was only used as an auxiliary means of live broadcasting. It was only a means of serving narrators and spectators in world-famous Grand Slam and Crown Tournament events. At this time, the “eagle eye” became truly world famous and became another “referee” in tennis, volleyball and other sports competitions. Hawkins, creator of the current “Hawkeye”, once said that the meaning of “Hawkeye” lies in overcoming the limits and blind areas of human observation ability and helping the judges to make accurate and fair judgment results.

3. Eagle Eye-Application of Instant Playback System in Tennis Match

3.1 Line Review

Hawk-Eye system can judge each near-line ball, and then replay the virtual lens to give the exact answer to whether the ball is out of bounds. Replaying the flight track of the virtual ball and marking the ground contact part. In the broadcast process, the audience can see the rotation of the high-speed ball, the trajectory of the ball speed, etc. intuitively and clearly, thus greatly arousing the enthusiasm and participation of the audience.

3.2 Ball speed

Direct serve scoring (ACE ball) in tennis matches is undoubtedly the most relaxed and domineering scoring method in tennis matches, and the pleasing degree of ACE ball can also make the audience clap their hands in amazement. However, the audience can only feel the speed of the ball from the visual point of view, so how

fast? It is well known that amateur tennis players can easily hit the ball with a speed of 100 km/h-150 km/h. For a normal human dynamic visual acuity, it is already a bit difficult, not to mention those high-level professional tennis players. The current record holder of serving speed is John Isner from the United States. His speed has risen to 253km/h, which is comparable to high-speed rail. Is it clear to human eyes? Hawkeye can quickly and accurately measure the ball speed of the players of both sides, whether in front of the net or at the bottom line, serving or hitting the ball. It can also analyze the influence of air, showing the process of slowing down the ball speed, providing a lot of rich speed information that can't be seen by human eyes. It can be said that the application of "eagle eye" technology in tennis matches can not only immediately obtain detailed and accurate data, but also greatly improve the sense of substitution of the audience.

3.3 Service Comparison

Serve plays an important role in tennis matches that cannot be ignored. Even many professional players are famous overseas for their direct scoring with a strong serve. With the help of "eagle eye" system, we can not only judge whether the incoming ball is within bounds, but also mark the direction and depth of serve, so that the audience can clearly see the comparison of each serve of the same player in this match, and let the audience deeply understand each player from the side. In addition to the service comparison, the eagle eye system tracks the ball and players throughout the match and can obtain a large amount of data. For example: placement of service, swing speed, ball speed, batting rate before the net, etc. These data can not only be the players' "report card" of the match, but also enable the players to find their own advantages and disadvantages and conduct a new round of purposeful and targeted special training.

3.4 Baseline Data

A 1920s tennis superstar from the United States, Burty Walden, once said: "Bottom line batting is the weapon used to defeat the enemy in tennis. The more sophisticated the weapons, the more chances there will be for victory. "In the seventies of the 20th century, the bottom line capability has undergone tremendous development. As Burty Walden said, the bottom line has become a weapon for many people to defeat the enemy in this tennis war. So how can this weapon be brought into full play? The Eagle Eye system is of great help "Hawk-Eye" system can not only analyze the ball distribution, but also track the player's ability to return the ball during the whole match. Therefore, various new data can be developed. By expanding these data, such as the player's running distance during the whole match, the hitting rebound point and other data, the player's self-knowledge can be further understood by the audience as well as the player's ability.

3.5 Rules for the Use of “Hawk Eye” in Tennis Tournament

The Eagle Eye Challenge has been in use since the 2006 Hopman Cup performance competition. It aims to give players the right to a fair and just decision. According to the “eagle eye” system, the human eye has realized the epoch-making change of challenging the “eagle eye”. Under the condition of “eagle eye”, tennis players can carry out “eagle eye challenge” and prove themselves by replaying the multi-angle tennis flight trajectory. If the player stops hitting the ball during the live period, he can use the “eagle eye” to determine the penalty according to the result. If the other player makes a mistake, the player wins the score. Otherwise, the score will be lost. If you are dissatisfied with the referee's decision, you can also request the use of “eagle eye” and score if the referee makes mistakes. On the contrary, the original judgment is upheld. First of all, there are 3 chances to challenge Hawk Eye with naked eyes in each set of matches. By the end of the set, none of them have been used. Then in the next set, you still have 3 chances not to add up. In addition, if you enter the seventh set, you will have another chance on the original basis. Secondly, for each set of “Eagle Eye Challenge”, one chance will be deducted if the challenge fails. If successful, those three opportunities will be retained and there will still be three opportunities for use. As a result, the quality and enjoyment of the whole match have been greatly improved. As we all know, morale in any match is also an essential winning factor. Once one side challenges success with great vigour and the other side is flagging, the result is not obvious.

4. Eagle Eye-Necessity of Introducing Instant Playback System

4.1 The “Hawk Eye” appears as an “authoritative referee” in court matches

With the eagle-eye system, even if the players have any doubts about the penalty, the referee can call up the flight trajectory picture of the tennis ball according to it so that the doubts are not hidden. Only when the penalty in the match is closer to fairness and justice can the “belligerence” of the players be improved and the continuous development of tennis be promoted.

4.2 “Eagle Eye” appears as a “dynamic analyst” during the course competition

As mentioned earlier, the “eagle eye” system has strong tracking ability and various detailed data even during the whole match, which gives the commentator and guest of the match sufficient information and enables them to use their talents to make independent comments. Before the previous “Hawkeye” system was introduced, the audience could only see the slow-motion replays of the players shown on the big screen, but they did not know why. However, the “Hawkeye” can let the audience really understand how tennis can reach a high speed of several hundred kilometers per hour from zero at the initial speed. From the “Eagle Eye” to the computer calculation of tennis flight trajectory, 10 seconds is more than enough and the accuracy rate is as high as 99%. For example, it provides the audience with a

God's perspective and a brand-new perspective to watch the competition from the other side.

4.3 “Eagle Eye” appears as “360 Live Broadcast” during the course match.

Hawkey can provide the audience with a 360-degree view of the competition space, and through system simulation, it will provide such a picture on the computer screen: tennis ball is like a shell with teeth and claws showing off Wu yaowei. the airflow brought up from the launch to the fierce rotation in the air will fall from the air like a fast meteor, and a close-up like a meteor crater will appear on the display screen. whether it is out of bounds is clear. the audience can not only see the flight trajectory at a glance, but also know the accurate data such as the location of the falling point. The playback system is like giving the audience another different flavor when watching live broadcast.

5. Eagle Eye-Impact and Development of Instant Playback System on Tennis Match

5.1 “eagle eye” guarantees the basic principle of fairness

The Eagle Eye system has become the defender of justice in the competition. It guarantees the basic principle of fairness. First of all, when a player disagrees with his/her decision during the match, he/she can apply, and the “eagle eye” system will simulate the actual path of the ball. secondly, the large screen will show the slow motion playback of the tennis ball from the player's racket to the landing. the standard distance error will not exceed 3mm, with the accuracy rate of 99%

5.2 “Eagle Eye” Supervision and Supervision of Judges

Due to the application of “eagle eye” technology, it has virtually played the role of supervision and supervision of the referee. In the process of tennis competition, due to various factors, the referee's misjudgment is always inevitable. The use of “eagle eye” system is not aimed at judges in essence, but actively acts in accordance with the basic principles of fairness, impartiality and openness. After using “eagle eye”, compared with the usual, we can find that the disputes between the referee and the players are gradually decreasing. this is not only a good start but also another aspect of the charm of competitive sports.

5.3 “Eagle Eye” shortcomings and deficiencies

“Eagle Eye” is a complicated and complicated simulation system. The “Eagle Eye” system was undoubtedly a fable at that time. At present, no company in our country can master it alone. For example, famous international companies such as

Omega jointly monopolize technology, and all prices remain high. The installation of Hawkeye costs a huge sum of US\$ 100,000, and the weekly maintenance cost of the stadium has reached US\$ 40,000. Therefore, the system is currently only installed in the indoor stadium of Miami Masters and the two courses of the US Open. For example, in 2006, the Chinese tennis tournament paid nearly 200,000 US dollars to rent the “Eagle Eye” system abroad, which was very expensive.

5.4 Future Development of Eagle Eye

Eagle Eye uses a dedicated high-definition high-precision camera to track players from both sides. It can collect data for each movement. So why not add a new system to realize data collection and data analysis together? Coaches and athletes can not only conduct repeated research and comparison of movements, so as to find out what are the advantages and disadvantages of movements, but also improve and train according to accurate data, which can stimulate athletes to improve their technical and tactical ability from the side. In traditional tennis, although athletes can put forward their own doubts to the referee, they cannot shake the referee's decision. Even if the referee misjudges, they can only sigh at the ocean. The addition of “Eagle Eye” gives athletes the right to safeguard their own rights and interests. Why is this not a progress from the past to the future?

6. Conclusions

“Eagle Eye” system is only used for the competition. After missing the miscalculation that is talked about with relish, it will return the competition to fair strength and will. We do not deny that the use of the “Hawk-Eye” system will lead to irrelevant contradictions, such as the organizers' worry about higher costs, but there is no doubt that the “Hawk-Eye” technology is essential to ensure the fairness of the competition. “Eagle Eye” system is imperceptibly promoting tennis to achieve a more long-term development, and will certainly form a qualitative leap in the whole competitive sports in the future.

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