Research and Development of the System of CBA Referee Image Point Playback

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ABSTRACT

In this paper, we develop a referee image acquisition system to establish the link between data and image to form a corresponding relationship, on the basis of the CBA Referee Spot Judgment Evaluation System (CAA) in 2012-2013. And the CBA referee's on -spot judgment video database is built. This study analyzes the overall demand and the function of each module at the demand of the system. And The whole system frame and the detailed module are designed. Finally the system is designed and tested. The system can easily query the various video clips, and can carry out various forms of comparison, statistical analysis. It can objectively reflect referees’ decision level; and provide the basis for the referee reasonable use and the referee training promotion. It also can provide the information for the referees' self-learning and improvement. And lay a solid foundation for the professional management of basketball referees in China.

THE ANALYSIS OF THE SYSTEM REQUIREMENTS

Modern basketball game scenes are more brilliant. Tall and strong, aggressive and tenacious, flexible, fast and actively become the development trend. Fierce competition, frequent physical contact, some are in line with the rules, some violations of the rules were banned. The task that accurately determine whether the physical contact and technical action is reasonable falls on the spot referee. It requires the referee to keep moving constantly with both offensive and defensive in the game, in order to select the best observation position. This requires not only referees clear-headed, quick thinking, high-intensity mental work, but also full of energy, rapid response to high-intensity physical labor.

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Basketball referees' business level and professional ethics plays a vital role in the game. The level of its rule enforcement on the development of basketball also plays a role in promoting and restricting. Referees are the organizers and managers of the game. Each penalty of the referee in the spot have a direct impact on the intensity of the game exciting and the level of athletes' skills and tactics. It can be said that the level of the referee directly affect the level of Chinese athletic basketball.

In the course of 20 years of basketball professional league in China, the referee's rule enforcement has gradually become the focus of attention. Referees' unfair penalty will affect their credibility in the fans, and lose confidence in the league fans. Concerned about the degree will be lower, and seriously undermined the basketball league market. Their level of rule enforcement directly determines the level of the league, therefore, with the continuous development of basketball and occupation of basketball, the referees' work attracts more and more people's attention.

In 2011, based on the investigation of the referee's execution, our research group established the index system which can accurately evaluate the level of referees' rule enforcement. On this basis, we designed the "Basketball Referee Spot Judgment Evaluation System"). The system is official started in the game from CBA2011 to CBA2015 for five consecutive seasons, each referee is equipped with a supervisor Acer ICONIA TAB (ICONA Tab W500-C62G03iss EAB00) on-site operation. In the touch screen interface, the speed of recording can be greatly improved. The display is more intuitive, and it is easy to operate. The supervisor shall be responsible for the data collection of the referee on the spot and the video will be verified by the supervisor after the match. In the practice tests we achieve the desired results, and has been generally recognized by basketball management center and colleagues.

However, the system lacks the image content and is not easy to query and referees' self-learning and improvement. Therefore, the research group investigated the referee management of NBA and found the similar referee image database in NBA referee management. If the system was developed and applied in CBA, it will play a significant role in promoting the CBA referee management and executive level.

The current international advanced technology analysis is to take data and image mode. The image analysis model can make a more effective and comprehensive analysis of the business level of the referees. And establish the referee image database to make it more convincing on the referee evaluation.

To this end, the research group tried to penalty image acquisition system, and establish the link between data and image to form a corresponding relationship, on the version of 2012-2013 "CBA referee on-site Executive Appraisal System (CAA)", and based on mainstream technology analysis of the "big data" and "cloud computing" concept. The CBA referee on-the-spot judgment video database can be generated, which can facilitate the query of the video clips in violation and fouls, and perform various kinds of comparison and statistical analysis. It also can objectively reflect the level of the Chinese basketball referee. And it can provide the basis for the referees' use, promotion and comprehensive assessment, and provide information for referees' training and self-learning. And lay a more solid foundation for the professional management of basketball referees in China.
SYSTEM ANALYSIS

System Analysis

The system according to the needs of users in accordance with the function of information maintenance staff (including game information and video information), spot judges, referees, basket management center management.

Information maintainer

Main Responsibilities: Responsible for collecting, maintaining, arranging and recording the information of the match, teams, referees and judges, as well as editing the video and uploading and managing the video.

spot judges, referees

Main Responsibilities: Login CBA referee "image playback, accurate analysis" system, watch the video.

Cannery management staff

Responsibility: Login CBA referee "image fixed-point playback, accurate analysis" system, watch the video, and establish the referees on-site penalty image video test database.

The Analysis of the Function of the System

The system can facilitate the realization of the video input, modify, query and other functions. For the login user, you can easily view their respective video. You can also press the judges by query, according to the referee, according to screening, according to the team query, according to the type of query, according to the results of the query, And other classification methods for video, learning. On the management staff. You can achieve the background of the system management, including video management, game information management, user management and so on.

Front-ground requirements

The foreground displays content according to different types of user rights, and the logged-in user can view video categories, view video details, and play videos.

(1) Homepage: According to different types of users to display the corresponding user's home page information

(2) Login: Enter the correct user name, password and verification code to enter the site.

(3) Search: by entering keywords, search for all the video information that contains the keyword.

(4) Detailed module: This module shows all the video information under the video category, including the video corresponding to the referee, judges, competition team, the type of punishment, results, time, etc.

(5) Playback module: the user through this page to watch video playback.

The analysis of management background needs

Back-office maintenance management data subsystem is the management of the game information, video and user.

(1) Event information management: Upload or edit the home team, visiting team information, referee, judge name.

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(2) Team information management: Upload or edit all the participating teams this season, the team's information.

(3) Judge Management: Uploads or edits information about all referees involved in the season.

(4) Referee management: Upload or edit all the judges in the season to participate in the evaluation of the information.

The Analysis of System Use Case

The analysis of system use case is a bridge between requirements and design. The system is divided into three modules, and complete the system use case diagram for each module.

Video module

The following figure shows the online video use case diagram. The main users of the map is ordinary users (referees, judges, basket management center managers) and system administrators. Ordinary users can search and play video. The system administrator can upload, edit, delete, query and other operations of video information.

Tournament information module

The following figure shows the use case diagram of the tournament information module. The main users of the map is ordinary users (referees, judges, basket management center managers) and system administrators. Ordinary users can view the event information, and the system administrator can upload information, edit, delete, view and other operations.

User management module

The following figure shows the user management module use case diagram. The main users of the map is ordinary users (referees, judges, basket management center managers) and system administrators. Ordinary users can modify the user password, and the system administrator can manage user information, add, modify, delete the user, and modify the user password.

The Analysis of Feasibility of System

Technical Feasibility

The analysis of technical feasibility mainly focus on whether technical conditions can successfully complete the development work, whether the hardware and software can meet the needs of developers. The system uses the current more extensive B / S model for development. MySQL database developed by the Swedish MySQL AB database, which can not only handle large amounts of data, but also to maintain data security and integrity, and can provide many advanced management functions. In hardware, hardware updates faster and faster, more and more capacity. Therefore, the hardware platform can fully meet the needs of this system and its development and use.

The video technology in the system uses HTML5 Video tag display, with the traditional way of custom players match two kinds of files----OGG and H.254. Compared to the traditional Flash player, this match has a larger advantage. In compatibility, due to the different browser core, the mainstream browser core has IE's Trident kernel, Firefox's Geoko kernel and Webkit kernel. HTML5-now JavaScript library will be based on the relevant nostalgia of its kernel to make
judgments, and adjust the elements mechanism. In addition, it also provides Flash, QuickTime, Java three players as uncertain, and facilitate the restriction for player requirements when we are using it.

**Economic feasibility**

Economic feasibility analyzes costs and profits, including project development costs, estimated development time, manpower and material resources. From the long-term point of view, the establishment of the system has great help for the CBA referee to enhance the ability of the Executive, It also can form a good sportsmanship and discipline, and is good for the referee's self-awareness and improvement. It will provide better and more rich information for the annual CBA referee training, too. The development of responsive website greatly improves the application of the website on the terminal device, which makes the application of the website more diversified, and reduces the limitation of the terminal equipment and improves the operability of the user. The development of the system is economically viable.

**Operational Feasibility**

With the continuous development of information technology, multimedia industry has been integrated into all walks of life, and the application will be more and more widely, so the system has a strong practicality. The development of multimedia Internet is the inevitable trend of the development of digital applications, and various intelligent software emerge in an endless stream, so that the referees and judges can learn from each other at lower cost and learn more easily.

**The Analysis of the Non-function of the System**

A non-functional requirement is a feature that the system must have in addition to the functional requirements in order to meet the user's business requirements. In the design of the system, we not only need to consider the functional requirements, but also need to consider some non-functional requirements.

1. **Page adaptation**
   In the design we need to combine the PC-side and mobile-side layout, and pay attention to the page's self-adaptability. When users use mobile devices to access the site, the page according to the screen size adaptive layout adjustment.

2. **Users' experience**
   The system is to meet the needs of users. The users' experience is an important standard of whether a system is excellent. How to better improve the users' experience in the system an important issue to consider. Such as page style should meet the user's aesthetic habits, and has a certain guide. Website logo to ensure that the theme is clear and does not occupy too much space. Page navigation should be clear, structured. The page size is suitable for multi-browser browsing. The page color should be consistent with the theme, to ensure that the user browsing comfort. Use pictures to be simple, easy to understand and accurate.

**DESIGN OF THE SYSTEM**

The design of the system includes the outline, the determination of the system framework and the function modules contained in the system, the detailed design of each function module, and the design of the database.
Overall System Architecture

Before the overall design of the system, it is necessary to understand the structure of the whole website, including the front page of the website, the logic interaction, the backend management background function, the front and back data interaction of the whole website, the front data API, the bottom system of the website, And other related logic. The backstage supporter passes the backstage management data, the video data, the user data into the database in the backstage supporter's backstage, after the back end fetches the corresponding data to provide data API to the front end, the front end fetches corresponding data according to data API, show data in the front page on.

Detailed Design of the System Function Module

Request flow on the system page
Access to the site, the server will receive the user to access the site device size information, and then use CSS3's MediaQuery to determine the user's device width, PC-side generally do not need to determine the width of the device directly to the initial style; PAD side width of 479px to 960px; PHONE-side width of 320px to 480px between. Depending on the device width size, the corresponding style is applied to produce the final page style.

Detailed design of the homepage
According to the functional requirements, the top area of the homepage contains the logo and website name; the middle area is the left and right structure, the left side is the picture, the right side is the landing area, and the bottom area is the common bottom.

Detailed design of the website homepage
The top area of the website contains the left logo and website name. The middle is the search area. The right side is the user information area. The middle area is left and right structure. The left side is the navigation bar, and the right side is the content area. The bottom area is the common bottom.

Detailed design of the video list page
The top area of the site video list page contains the left logo and website name. The middle is the search area, and the right side is the user information area. The middle area is left-right structure. The left side is the navigation bar, and the right side is the list area. The bottom area is the common bottom.

Detailed design of the event information page
The top area of the website tournament information page contains the left logo and website name. The middle is the search area. The right side is the user information area; the middle area is left and right structure, the left side is the navigation bar, the right side is the tournament information management area; the bottom area is common bottom.

Detailed design of the video management page
The top area of the site video information page contains the left logo and website name. The middle is the search area. The right side is the user information area; the middle area is left and right structure, the left side is the navigation bar, and the right side is the video information management area; the bottom area is common bottom.
**Detailed design of the user management page**

The top of the site user management page contains the left logo and website name. The middle is the search area. The right side is the user information area. The middle area is the left and right structure. The left side is the navigation bar, and the right side is the user management area. The bottom area is the public area bottom.

**Design of the System Security**

As the system is based on the Internet's information management system, the system security and confidentiality is very important. The system from the following three aspects to achieve the encryption / authentication design.

*Login Authentication*

The relevant person using the system have to log on to the system prior to the CBA management center in real-name registration, and set the login password. After the game by entering the correct login name and password to enter the evaluation interface. Irrelevant person can not login. Login authentication is the first level data upload security technology.

*Data Upload / Download Binding Authentication*

The computers, PDAs or other handheld devices used by the supervisors must be authenticated and bound in the CBA Management Center before MAC address authentication. Only the equipment that has been bound to the MAC address by the CBA management center can upload data and effectively avoid illegal Machine may tamper with the data. Data Upload / Download Hardware Binding Authentication is the second level data upload security technology.

*Data encryption design*

The Internet is an open network. The data transmission may be monitored or even tampered with, so the system uses the most secure data encryption algorithm (MB5) to ensure data security. Data encryption is the third level data upload security technology.

**System Development Platform**

The system is designed with C / S (client / server) architecture. The front-end uses Html5 and JavaScript for interface design. The server uses Mysql database for data storage. The front-end exchange data with the server through Ajax request.

Above content from the overall design of the system, describes the overall framework of the system and the various modules, and determine the detailed function of each module. And then for each module to complete the page design, and finally complete the detailed design of a database module functions.

**SYSTEM TESTING**

A series of tests are required after the system is developed and before it is released to the public. This chapter introduces the testing process and the problems encountered during the test and the solutions.
**Test Flow**

When a website or a stage of development is basically completed, the following three steps test is needed to pass:

1. **Producer test:** Including the art test page and the function of programmer test. In the first time after the completion the producers begin to test by themselves.
   - Page: Including home page, two pages, three pages of pages in a variety of commonly used resolution without dislocation; whether the pictures have typos; whether the connection is dead connection; the corresponding section of the picture and content and so on.
   - Function: to meet customer requirements; database connection is correct; each dynamically generated connection is correct; transfer parameter format, content is correct; and the test content is not being given error.

2. **A comprehensive test:** A comprehensive test is needed by a specially assigned person according to the delivery standards and planning group requirements, including pages and procedures. The two aspects should be measured together to ensure adequate content will not lead to fill the page after the deformation. In addition to check whether typos, it is important to check whether the contents of the text have common sense errors, and to check whether human-computer interaction interface or the error message prompts are friendly.

3. **Release test:** The test after the web site published to the main server is mainly to prevent the environment caused by different errors.

**Test Content**

According to the testing process, we need to complete the following test content:

1. **Functional testing:**
   - Link testing: Link testing must be completed in the integration testing phase, that is, the link test is after the completion of all pages of the entire Web application development.
   - Form test: The main test methods are: boundary value test, equivalent class test, and abnormal class test.
   - Cookies test: The test content can include whether Cookies are working, whether saved according to the scheduled time, and whether refresh have any effect on Cookies.
   - Design language testing: Web design language version of the differences can cause serious problems client or server side, in addition to HTML version of the problem, different scripting languages, such as Java, JavaScript, ActiveX, VBScript or Perl, also to verify.
   - Database testing: Mysql comes with a tool to test database performance, to test the performance of a variety of databases.

2. **Performance testing:**
   - Connection speed test: If the Web system response time is too long, the user will not have the patience to wait and leave. Moreover, the connection speed is too slow, may also cause data loss. The user can not get the real page.
   - Load testing: Load testing is to measure the performance of the Web system at a certain load level, in order to ensure that the Web system can work normally in the
demand range. The load level can be the number of users accessing the Web system at a time, or the number of online data processing.

Stress test: Stress test is the actual destruction of a Web application system—a reflection of the test system. Stress testing is a test of system limitations and fault recovery capabilities, that is, testing the Web application system will not collapse, under what circumstances will collapse.

3) Usability testing:

Navigation test: You can decide whether a Web application is easy to navigate by considering the following questions: Is the navigation intuitive? Is the main part of the Web system accessible through the home page? Does the Web system require a site map, search engine, or help from other navigation?

Content testing: Content testing is used to verify the correctness, accuracy, and relevance of information provided by Web applications. The correctness of information refers to whether the information is reliable or misleading.

Overall interface test: The overall interface refers to the entire Web application system. The page structure is designed to give users a sense of the whole.

4) Compatibility testing:

Platform testing: The end user of Web application system use what kind of operating system? It depends on the user's system configuration. In this case, compatibility issues may occur, the same application may be able to run under certain operating systems, but in other operating systems may fail to run.

Browser testing: One way to test browser compatibility is to create a compatibility matrix. In this matrix, test the adaptability of different vendors, different versions of the browser to certain components and settings.

5) Security test:

Directory settings: The first step of web security is to set the correct directory. There should be an index.html or main.html page in each directory so that nothing in that directory will be displayed.

Login: You must test the valid and invalid user name and password, pay attention to whether the case-sensitive, you can try the number of restrictions, whether you can not visit a direct visit to a page.

Session: Whether web application system has overtime restrictions, that is, after landing a certain period of time (for example, 15 minutes) the user did not click on any page, whether he or she need to re-login to normal use.

Encryption: When using a secure socket, we need to test whether the encryption is correct, and to check the integrity of information.

Security vulnerabilities: Server-side scripting often poses security vulnerabilities that are often exploited by hackers. Therefore, we must test without authorization, it can not be placed on the server side and edit the script.

SYSTEM APPLICATIONS

Video Clips

In the end of the game, the supervisors get the video discs of the game at the end of the game, and import the video into the computer for video editing.

1) Quick-add video

Method one: open the folder where the video file, and drag the video directly to the "Video" tab.
Method two: Click the "Video" tab at the top of the main interface of the software, click the "Add Video" button below the video list, or double-click the text in the "Added clip" list below to quickly add the video.

(2) Clip the video

Method one: In the upper right corner of the main interface and the basket of time progress bar, click on the downward bulge downward arrow (shortcut Ctrl + E), open the "innovative timeline" panel, and check out the exact location combined with "audio waveform" Super scissors hand".

Method two: Add video, or double-click the bottom of the "Added Sections" panel clip thumbnail, enter the "Preview / Intercept" dialog box, through the "Ctrl + E" to bring up the timeline, combined with the method one select the desired screen, click the Dialog box, "the beginning of the interception time" and "the end of the interception time", with the left arrow picking small button to quickly pick up the current picture of the time point can be intercepted video clips.

(3) Export the video

After editing the video, click Export Video in the lower right corner of the video preview box. In the Export Settings dialog box, enter the name of the exported video in the format of "Session" - "Home" - "Referee" "Type" - "results", the export format for the "mp4" format. The producer's name is the supervisor's name.

**Video Input**

(1) Landing the system of CBA referee "image fixed-point playback, accurate analysis"

Enter the user's name, password and verification code, then enter the CBA referee "image playback, accurate analysis" system

(2) Into the video management module.

Click on the video management, enter the video management module, and select the corresponding season and screening.

**CONCLUSION**

In this paper, the CBA referee "image fixed-point playback, accurate analysis" system is the emphase for research. The system will be summarized.

(1) The system draws on the United States NBA referee image software and the thinking of ability to evaluate the preparation;

(2) According to the existing information, detailed collate and analyze the system requirements;

(3) Using HTML5, css3, Bootstrap technology to achieve the system front page;

(4) To complete the database design;

(5) To achieve system functions, including video playback, user management, event information management;

(6) To test the system.

(7) The establishment of CBA referee image database;

(8) The establishment of basket management center and the referee port. Make it convenient for basket tube center and the referee to check at any time;
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