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EXPLORING CHINESE INTERACTION MODELS IN INTERNATIONAL SPORTS EVENTS THROUGH MULTI-CHANNEL DATA FUSION

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ABSTRACT

This study addresses the challenges of engaging Chinese-speaking audiences in international sports events due to fragmented communication models and limited media integration. A novel interaction model based on multi-channel data fusion is proposed to enhance information dissemination and user engagement. The model integrates data from traditional media, internet media, and social media into a cohesive platform, utilizing advanced data fusion techniques, microservices architecture, and technologies such as Docker, Kubernetes, and WebSocket for high availability and real-time interaction. Additionally, Nginx with the RTMP module and Akamai CDN ensures high-quality streaming services. Experimental results demonstrate the platform's effectiveness in data integration, content publishing, and real-time user interaction, significantly improving Chinese engagement in international sports events. This research provides practical strategies for event organizers to enhance communication, leading to higher audience satisfaction and participation, and contributes to the theoretical framework of sports event communication through innovative and inclusive practices.

KEYWORDS: Multi-Channel Data Fusion; International Sports Events; Chinese Interaction Model

1. INTRODUCTION

The globalization of international sports events has been a significant trend over the past few decades, driven by advancements in media technology,

economic globalization, and the increasing mobility of athletes and spectators (Gruneau & Horne, 2015). Events such as the Olympic Games, the FIFA World Cup, and major tennis tournaments have become global spectacles, attracting millions of viewers and participants from around the world. In this context, effective communication and interaction among diverse linguistic and cultural groups are essential (Jiang & Xiao, 2021). Among these groups, Chinese-speaking audiences represent a significant and growing segment. With over 1.3 billion native speakers, Chinese is the most spoken language globally. The rise of China as a major player in international sports, both as a host of events like the Beijing Olympics and as a source of top-tier athletes, further underscores the necessity of efficient Chinese communication channels (YAN, 2023). Although international sports events have a global nature, communication and interaction with Chinese-speaking audiences often face significant challenges. The current interaction models are fragmented and do not fully leverage the diverse communication channels available today, such as social media, live streaming platforms, and instant messaging apps (Anders, 2016). This results in a disjointed user experience, limiting engagement and reducing the overall impact of the events on this significant audience segment. Despite the growing importance of Chinese-speaking audiences, current communication strategies often fall short of meeting their needs (Hu, 2024). Many international sports events provide limited Chinese language support, and when available, it is often not well-integrated across different media and platforms. This gap highlights the need for a more cohesive and comprehensive approach to engaging Chinese-speaking audiences, one that leverages the full spectrum of available communication channels and technologies (Lu, 2021). As shown in Figure 1, the channels for Chinese media interaction in international sports events are illustrated.

Figure 1: Diagram of Chinese Interaction Channels in International Sports Events

To address these challenges, this study aims to propose and validate a novel Chinese interaction model based on multi-channel data fusion (H. Li & Huang, 2007). This model seeks to enhance the dissemination of information and user engagement during international sports events by integrating data from various communication channels into a cohesive and interactive platform. By leveraging advanced data fusion techniques, the proposed model will facilitate real-time interaction and provide a more seamless and immersive experience for Chinese-speaking audiences. Specifically, the objectives of this research are:

1. To develop a comprehensive model that incorporates multi-channel data fusion to improve Chinese communication during international sports events.

2. To evaluate the effectiveness of this model in enhancing information dissemination and user participation.

3. To provide actionable insights and recommendations for event organizers and stakeholders to implement this model effectively.

This study contributes to the existing body of knowledge on sports communication by introducing a new perspective on the integration of multi-channel data fusion in enhancing audience engagement. It expands the theoretical framework of sports event communication and interaction, offering a novel approach that can be further explored and refined in future research. For event organizers and participants, this research offers practical tools and strategies to improve communication with Chinese-speaking audiences. By adopting the proposed multi-channel data fusion model, organizers can create more efficient and engaging platforms for interaction, leading to higher levels of audience satisfaction and participation. This model also has the potential to attract more sponsors and partners by demonstrating a commitment to innovative and inclusive communication practices (Wang, 2023). In summary, the globalization of international sports events necessitates effective communication models that cater to diverse linguistic and cultural groups. By focusing on the integration of multi-channel data fusion, this research aims to address the current limitations and provide a robust framework for enhancing Chinese communication and interaction during these global spectacles (Zhang & Zhang, 2023).

2. Methodology

In traditional international sports event interaction modes in Chinese, event organizers sell broadcasting rights to media rights holders, who then provide video, images, and other media content (Hutchins, Li, & Rowe, 2019) to traditional media outlets such as television stations, radio stations, and newspapers, as well as to internet media such as news websites and video

platforms, and self-media platforms such as short video, live streaming platforms, and Weibo. These platforms process the media content and provide it to the audience. During this process, traditional media lack interaction with the audience, making real-time engagement difficult (Strekalova, Krieger, Damiani, Kalyanaraman, & Wang, 2018). Internet media allow interaction through comments and bullet screens, enabling audience and information providers to interact. Self-media platforms allow audiences to interact with operators through comments, bullet screens, and even tipping. Currently, real-time interaction in international sports events is primarily facilitated by internet and self-media, while traditional media still have shortcomings (B. Li, Scott, Sharper, & Wang, 2023). Audience interaction is often limited to single-platform engagement, hindering broader cross-platform interaction. Moreover, the dispersed nature of platforms and interaction forms makes it challenging to monitor interactions effectively, allowing the potential spread of harmful information. The traditional Chinese communication model for international sports events is illustrated in Figure 2.

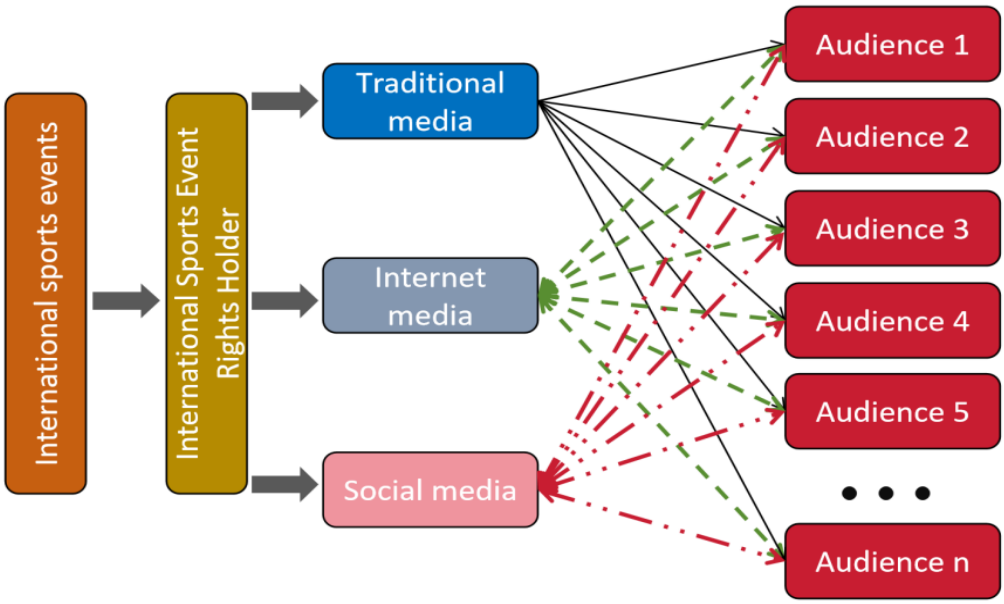

Figure 2: Diagram of the Traditional Chinese Interaction Model in International Sports Events

This study proposes a fusion platform between various media channels and audiences. This platform integrates dispersed media information and provides it to a wider audience, who can interact with the information on the fusion platform to access multi-channel information comprehensively and engage in cross-platform interactions (W. Li & Abidin, 2023). This approach effectively increases the exposure of information across platforms and offers an efficient Chinese interaction mode. Moreover, overall monitoring of the fusion platform can identify and eliminate harmful or infringing information in real-time. The integrated channel interaction model for international sports events is illustrated in Figure 3.

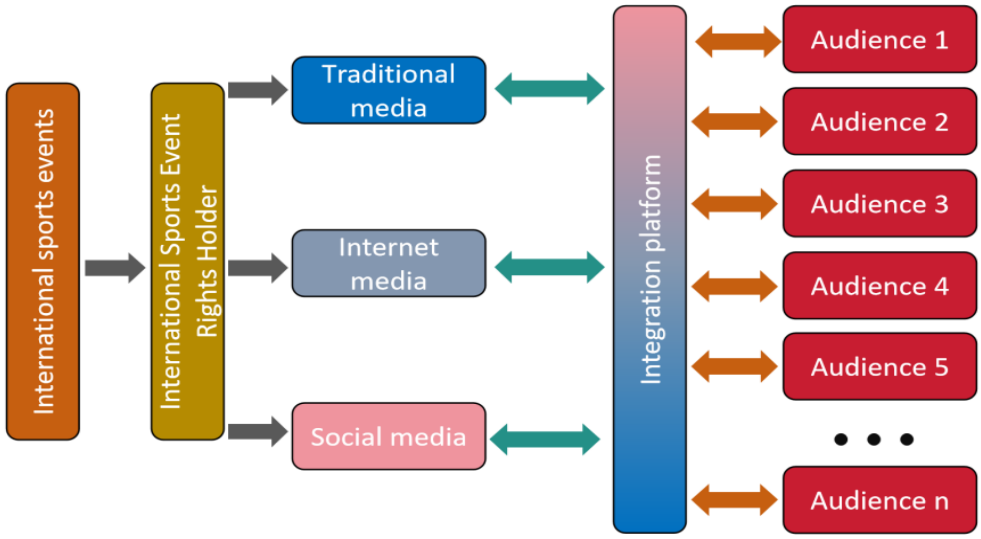

Figure 3: Diagram of the Multi-Channel Integrated Chinese Interaction Model for International Sports Events

This chapter details the implementation process of the multi-channel data integration interactive platform for international sports events. The process includes three main steps: multi-channel information acquisition, content integration, and platform development. To ensure the platform can handle and publish high-quality streaming data, we chose the most suitable technologies for streaming data processing. The development process of the multi-channel data fusion Chinese interaction platform for international sports events is shown in Figure 4.

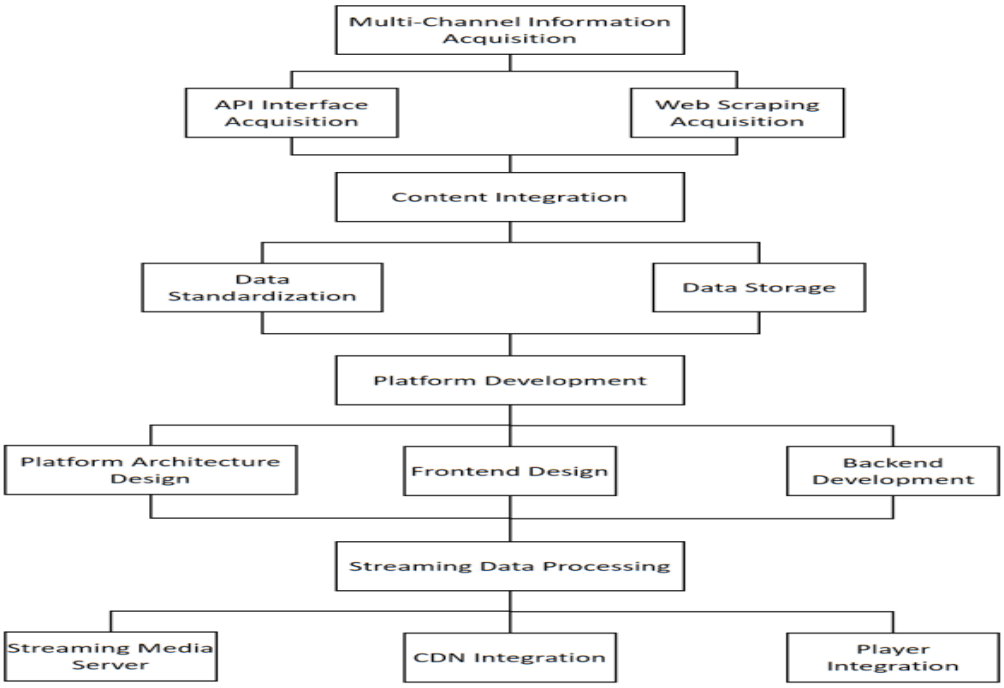

Figure 4: Implementation Process for a Multi-Channel Integrated International Sports Event Interactive Platform

2.1 Multi-Channel Information Acquisition

To implement the multi-channel data integration interactive platform for international sports events, it is essential first to acquire relevant event information from various media channels, including traditional media, internet media, and social media. API interfaces provide an effective way to acquire data from internet and social media platforms (Lomborg & Bechmann, 2014). By accessing the target platform's developer documentation, we understand the functionalities and data formats provided by their APIs and obtain API keys and access permissions. Using the HTTP GET method, we retrieve data from these APIs and process the JSON or XML response data. This process is implemented using Python's requests library (Tang, 2024). For traditional media content that cannot be obtained via APIs, web scraping techniques are used to automatically access and parse webpage content (Uzun, 2020). Using browser developer tools like Chrome Dev Tools, we inspect the HTML structure of the target webpage to locate the required data tags and attributes. Then, we write web scraping scripts using Python's Beautiful Soup library to parse the HTML content and extract the necessary data. Additionally, for complex web scraping tasks, the Scrapy framework is used, and for scenarios requiring user interaction simulation, Selenium is employed.

2.2 Content Integration

After acquiring multi-channel information, the data needs to be standardized and integrated to ensure a unified content format, which is then stored in a database. The goal of data standardization is to convert data from different sources into a uniform format for subsequent processing and analysis. Firstly, a unified data structure is defined, including fields such as title, content, source, publication date, etc. (Penteado, Maldonado, & Isotani, 2023). The acquired data is then cleaned to remove invalid information and converted into a standardized format. Data cleaning and conversion are handled using Python's Pandas library, which efficiently processes and transforms large-scale data. Standardized data is stored in a database to ensure data persistence and query ability. To meet the requirements of efficient storage and querying, MongoDB is selected as the primary data storage solution. MongoDB, a NoSQL database, is particularly suitable for storing JSON-formatted document data. Additionally, Elasticsearch is used for scenarios requiring full-text search and real-time analysis. The combination of MongoDB and Elasticsearch provides robust data storage and search capabilities, ensuring efficient data management and quick retrieval.

2.3 Platform Development

After achieving content acquisition and integration, a fusion platform needs to be developed to provide integrated information to users and support

various interactive forms. A microservices architecture is chosen to design an efficient and scalable fusion platform. This architecture allows independent deployment and scaling of different functional modules (e.g., data acquisition, data processing, user management). Each module communicates through RESTful APIs or message queues. To ensure environmental consistency and simplify the deployment process, Docker is used to containerize each microservice. Docker provides a lightweight containerization solution that significantly enhances development and deployment efficiency. For automated deployment, scaling, and management of services, Kubernetes is used for container orchestration and management, offering strong container orchestration capabilities to ensure high availability and fault tolerance of services. The front-end design aims to provide a user-friendly interactive interface supporting various interaction forms (e.g., comments, bullet screens, tipping). Modern front-end frameworks like React or Vue.js are used to develop responsive web interfaces, ensuring a good user experience. Responsive design adapts to different devices and screen sizes, ensuring excellent display on various terminals. To achieve real-time interaction between users, integrating WebSocket or other real-time communication technologies is necessary. WebSocket enables full-duplex communication, supporting real-time comments and bullet screens, thus providing a more interactive experience for users. The back-end development needs to implement data processing, integration, and publishing functions to support various front-end requests and interaction needs. Firstly, RESTful API services are built to handle front-end requests, providing data interfaces, and supporting data CRUD operations. Back-end development can use frameworks like Flask, which offer strong RESTful API support. Additionally, the back-end needs to implement real-time data processing and publishing functions to ensure users can receive the latest event information promptly. To ensure efficient data processing and publishing, adopting a message queue like RabbitMQ for asynchronous data processing and distribution is an effective technical solution.

2.4 Streaming Data Processing

Streaming data processing is a core function of the international sports event interactive platform, involving live and replay video processing and publishing. Deploying a streaming server is a critical step in handling video streams. Nginx with the RTMP module provides efficient video stream reception, transcoding, and distribution functions, suitable for large-scale concurrent access scenarios. To improve video stream transmission speed and user viewing experience, using a content delivery network (CDN) is necessary. CDNs cache video streams at nodes closest to users, reducing latency and buffering. Akamai is chosen as the CDN service provider, offering global acceleration and distribution capabilities. The final step in implementing streaming playback is integrating a video player in the front end. Video.js is chosen as the video player, supporting various video formats and adaptive

bitrate streaming (ABR), which automatically adjusts video quality based on network conditions to ensure the best viewing experience. Through these steps and technical methods, a multi-channel data fusion international sports event interactive platform can be implemented. This platform can efficiently acquire, integrate, and publish event information, providing a good user interaction experience and streaming playback capability. By adopting the most suitable technologies for streaming data processing, the platform can offer stable, low-latency, high-quality video streaming services, meeting users' needs for event live streaming and interaction.

3. Experiments

This chapter details the experimental design, implementation process, and result analysis. The experiments aim to validate the performance and functionality of the multi-channel data fusion international sports event interactive platform.

3.1 Experimental Environment Setup

The experimental environment setup section describes the hardware and software environment configuration, providing basic support for the experiments. The software and hardware environments are shown in Table 1 and Table 2, respectively.

Table 1: Hardware Environment

SERVER CONFIGURATION	CLIENT CONFIGURATION
CPU: INTEL XEON E5-2678 V3 @ 2.50GHZ	CPU: Intel Core i7-9700K @ 3.60GHz
MEMORY: 64GB	Memory: 16GB
STORAGE: 1TB SSD	Storage: 512GB SSD
NETWORK: 1GBPS	Network: 1Gbps

Table 2: Software Environment

SOFTWARE ENVIRONMENT	SOFTWARE VERSION
OPERATING SYSTEM	Ubuntu 20.04 LTS
PROGRAMMING LANGUAGE	Python 3.8, JavaScript (Node.js)
DATABASE	MongoDB 4.4, Elasticsearch 7.9
CONTAINERIZATION TOOL	Docker 20.10
CONTAINER ORCHESTRATION TOOL	Kubernetes 1.19
FRONT-END FRAMEWORK	React 17
BACK-END FRAMEWORK	Flask 1.1.2
STREAMING SERVER	Nginx with RTMP module
CDN SERVICE	Akamai
VIDEO PLAYER	Video.js

3.2 Data Collection

This section explains the process of collecting and processing data from different channels to ensure data quality and consistency. Data collection involves acquiring data through API interfaces from internet and social media platforms and web scraping from traditional media websites. API interfaces provide an effective way to collect data from internet and social media platforms. By accessing the developer documentation of the target platforms, we understand the functionalities and data formats provided by their APIs and obtain API keys and access permissions. Using the Python requests library, we send HTTP GET requests to retrieve data from these APIs and process the JSON or XML response data. The sources of API data collection are listed in Table 3.

Table 3: API Data Sources

WEBSITE	API LINK
SINA SPORTS	http://api.sina.cn/sinago/list.json?channel=news_sports
SINA SPORTS EVENTS	http://api.sina.cn/sinago/list.json?channel=hdpic_story
SCOREBAT	https://www.scorebat.com/video-api/
API-FOOTBALL	https://www.api-football.com/documentation-v3
2024 OLYMPICS DATA API-SPORTSDATA	https://www.explinks.com/api/scd20240628027413d88942
OLYMPIC HISTORY DATA	https://www.gugudata.com/api/details/olympic
FIFA DATA	https://givevoicetofootball.fifa.com/api/v1
DOUYIN	https://v.api.aa1.cn/api/douyin-hot/index.php
KUAISHOU	https://open.kuaishou.com/api/v1/item/get

For traditional media content that cannot be obtained via APIs, we use web scraping techniques to automatically access and parse webpage content. First, we use browser developer tools (e.g., Chrome Dev Tools) to inspect the HTML structure of the target webpage and identify the tags and attributes containing the required data. Then, we write web scraping scripts using Python's Beautiful Soup library to parse the HTML content and extract the necessary data. For scenarios requiring user interaction simulation, we use the Selenium library. For complex web scraping tasks, we use the Scrapy framework. The sources of web scraping data collection are listed in Table 4.

Table 4: (a) Web Scraping Data Sources

WEBSITE	URL
CHINA SPORTS NETWORK	http://www.99pen.cn/
SPORTS CHINA	http://sports.china.com.cn/
TITAN SPORTS WEIBO	https://www.weibo.com/titannews
SPORTS INFORMATION NETWORK	https://www.sportinfo.net.cn/Index.aspx

Table 4: (b) Web Scraping Data Sources

WEBSITE	URL
CCTV OLYMPIC CHANNEL	https://sports.cctv.com/Paris2024/index.shtml?spm=C96370.PPDB2vhvSivD.E59hodVIdh2C.7
CHINA NATIONAL RADIO NEWS	https://news.cnr.cn/
CHINA SPORTS DAILY	http://www.chinasportsdaily.cn/tyb/html/2024-08/03/node_116878.htm
CHINA SPORTS DAILY WEIBO	https://weibo.com/p/1002063693128121/home

3.3 Data Processing

After acquiring multi-channel information, the data needs to be standardized and integrated to ensure a unified content format, which is then stored in a database. The goal of data standardization is to convert data from different sources into a uniform format for subsequent processing and analysis. First, a unified data structure is defined, including fields such as title, content, source, publication date, etc. The acquired data is then cleaned to remove invalid information and converted into a standardized format. Data cleaning and conversion are handled using Python's Pandas library, which efficiently processes and transforms large-scale data. The standardized data is stored in a suitable database to ensure subsequent query and analysis. To meet the requirements of efficient storage and querying, MongoDB is selected as the primary data storage solution. MongoDB, a NoSQL database, is particularly suitable for storing JSON-formatted document data. Additionally, Elasticsearch is used for scenarios requiring full-text search and real-time analysis. The combination of MongoDB and Elasticsearch provides robust data storage and search capabilities, ensuring efficient data management and quick retrieval.

3.3.1 Platform Function Testing

Function testing aims to verify the stability and efficiency of various platform functions, including data integration, content publishing, and real-time interaction.

3.3.2 Data Integration Testing

Data integration testing mainly examines the platform's ability to acquire data from different channels, perform standardized processing, and store it in a database. During the test, data acquired through API interfaces and web scraping is imported into the platform and subjected to data cleaning, de-duplication, and standardization conversion. By comparing the data before and after processing, we ensure data structure consistency and integrity. Additionally, the test includes evaluating the storage and query performance of MongoDB and Elasticsearch databases, ensuring data can be quickly and accurately stored and retrieved.

3.3.3 Content Publishing Testing

Content publishing testing verifies the platform's ability to publish integrated data to the front end. By simulating user requests, we test the response speed and stability of the platform's RESTful API service. The test content includes data CRUD operations and data display effects on the front-end interface. To ensure users can promptly receive the latest event information, the test also includes real-time data processing and publishing functions. Test results show that the platform can process large amounts of data in a short time and efficiently publish it to the user interface, ensuring smooth and timely user experience.

3.3.4 Real-Time Interaction Testing

Real-time interaction testing mainly examines the platform's ability to support various interactive forms, including comments, bullet screens, and tipping. By integrating WebSocket technology, we test the real-time communication effect between users. Test content includes the real-time display effect of user-posted comments or bullet screens and the stability and response speed of the tipping function. During the test, the platform can efficiently process and display user interaction information, ensuring real-time communication and interaction experience between users. Additionally, the test includes monitoring and filtering of harmful information, ensuring a healthy and safe interaction environment on the platform. Through the above function tests, the multi-channel data fusion international sports event interactive platform's stability and efficiency in data integration, content publishing, and real-time interaction are verified. The platform can efficiently acquire, integrate, and publish event information and provide a good user interaction experience, offering comprehensive and diverse channels for obtaining and interacting with event information.

4. Conclusion

This study proposes and implements an innovative interaction platform that successfully addresses the issues of insufficient interaction and information fragmentation in traditional models. By using API interfaces and web scraping techniques, the platform effectively acquires data from internet media, social media, and traditional media, and ensures information uniformity and completeness through data cleaning, standardization, and integration. The platform adopts a microservices architecture, uses Docker and Kubernetes for containerized management, ensuring high availability and scalability of the system. In terms of user interaction, the platform front-end is developed using the React framework and integrates WebSocket technology to achieve real-time interaction features such as comments, bullet screens, and tipping, significantly enhancing user experience. Additionally, by deploying Nginx with

the RTMP module and Akamai CDN, the platform provides high-quality streaming services, ensuring low latency and high stability for event live streaming. Experimental results demonstrate that the platform excels in data integration, content publishing, and user interaction, effectively enhancing the level of Chinese interaction in international sports events. In the future, the platform can further improve user interaction experience and satisfaction by optimizing data processing and enhancing intelligence. This research introduces a comprehensive and effective solution to the challenges faced in Chinese interaction during international sports events, providing valuable insights and practical tools for event organizers and stakeholders. By adopting the proposed multi-channel data fusion model, organizers can create more efficient and engaging interaction platforms, leading to higher levels of audience satisfaction and participation, and attracting more sponsors and partners through innovative and inclusive communication practices.

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