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Augmented Reality Interaction Method for Instant Music Video Intelligent Recommendation Algorithm Technology in Multimedia Background

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Abstract: *With the rise of mobile internet and social media, instant music videos have become a key form of entertainment and information access. Traditional recommendation algorithms often fail to meet diverse user preferences, leading to suboptimal experiences. This study introduces an intelligent recommendation algorithm enhanced with an augmented reality (AR) interaction method to provide more accurate and personalized content. User behavior data is analyzed to build a recommendation model based on content and user profiles. The AR interaction method integrates recommendation results with real-world scenarios, enabling users to intuitively experience the relevance and appeal of suggested videos. In experiments comparing this method with traditional multimedia recommendation approaches, the AR-based algorithm achieved an average recommendation accuracy of 42.21%, a content diversity score of 91.86, and a user satisfaction score of 94.38. These results demonstrate that combining intelligent recommendation algorithms with AR interactions can effectively align instant music video suggestions with user preferences, enhancing engagement and platform dependency.*

Keywords: *Instant Music Video, Intelligent Recommendation Algorithm, Augmented Reality Based Interaction Techniques, Mobile Internet, Social Media*

1. Introduction

Instant music video, as a new form of multimedia, has developed rapidly since 2016 and has become one of the important forms of content in the era of mobile Internet. With the popularization of smartphones and network technology, more and more people are starting to use instant music video applications to obtain information, entertainment, and social interaction. In this context, how to provide users with more accurate and personalized recommendation services has become an important challenge faced by the instant music video platform. Traditional recommendation algorithms often only rely on users' historical behavioral data for recommendations, and cannot fully consider users' personal interests and preferences. Therefore, utilizing intelligent algorithm technology to provide personalized recommendations to users has become an important way to solve this problem. The significance of instant music video intelligent recommendation algorithm in the context of multimedia lies in its ability to fully utilize the characteristics of video itself and multimedia resources, and analyze and mine user behavior data through deep learning and other technical means, thereby achieving more refined and personalized recommendation services.

With the continuous development of instant music video, how to use instant music video intelligent recommendation algorithms to accurately match video content that suits users' interests has become a concern of major video platforms. Therefore, many people have also studied related intelligent recommendation algorithms. Shu Jiangbo mentioned in his research that automatic recommendation of multimedia learning resources could enable students to discover learning resources that matched their interests, and enabled electronic learning systems to locate learning resources to suitable students. In the research, the team proposed a content-based recommendation algorithm based on convolutional neural network. The main novelty of this recommendation algorithm was that it directly used text information to make content-based recommendations without labeling [1]. Cui Zhihua mentioned that traditional recommendation algorithms could not meet the fast and accurate recommendation needs of users in the Internet of Things environment. He proposed a novel recommendation model based on time correlation coefficient and improved cuckoo search K-means, which could gather similar users together to further quickly and accurately make recommendations [2]. Yi Baolin mentioned in his

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research that automatic recommendation became an increasingly relevant issue in the industry, which allowed users to find new products that meet their interests. Therefore, he proposed a collaborative filtering framework based on deep learning. Experimental results on five public databases showed that the proposed method was better than the recommendation algorithm based on deep learning in accuracy and training efficiency in quantitative evaluation [3]. Vedavathi N proposed an efficient e-learning recommendation system based on user preferences using hybrid optimization algorithms for e-learners. The system would be implemented and validated in a large number of e-learning items targeting customer preferences within some undefined time frames, and proved to be more proficient and accurate compared to traditional recommendation frameworks [4]. The above research content is all about how to use recommendation algorithms to match user preferences, and these studies have played a certain role in recommending preferred content for users.

Augmented reality is a technology that combines virtual information with the real world. Through computer vision, sensors, and artificial intelligence techniques, virtual information such as digital images, videos, and audio is superimposed onto real scenes, allowing users to more intuitively feel the existence of virtual information. Therefore, many people have studied its related applications in this technology. Qiu Chan mentioned in his research that in recent years, augmented reality and digital twin technology, with their characteristics of virtual reality integration and interactive control, brought new opportunities and challenges to the digital assembly of complex products. He elaborated on the concept and connotation of augmented reality, listed typical augmented reality assembly system structures, and analyzed the key technologies and applications of augmented reality in digital assembly [5]. Lampropoulos Georgios mentioned that augmented reality provided users with a new way of real-time interaction with the physical world and the digital world. The research team discussed how the integration of deep learning, semantic network, knowledge graph and augmented reality could improve the experience quality and service quality of augmented reality applications to promote and improve users' daily life [6]. Ahmad Nur conducted a systematic and comprehensive analysis of the research trends in the application of augmented reality in mathematical learning from 2015 to 2019. Through a comprehensive review of augmented reality in mathematical learning, researchers and educators could benefit, thereby proposing avenues for future research [7]. By identifying, summarizing, and discussing the definition of augmented reality, augmented reality applications related to retailers, and the value that augmented reality provides to retailers and consumers, Caboni Federica reviewed augmented reality in the retail industry and finally identified the specific value that augmented reality applications might provide to consumers and retailers [8]. The above research is all about the application of augmented reality in various fields, and these studies indicate that the application of augmented reality is beneficial for this field.

In the context of multimedia, the instant music video intelligent recommendation algorithm with augmented reality interaction can provide users with a richer and more vivid viewing experience, while also improving user satisfaction and stickiness. Specifically, analyzing and mining user behavior data can recommend instant music video content that is more in line with their interests and preferences. Through augmented reality interaction technology, virtual information is combined with real scenes, allowing users to more intuitively experience the fun and interactivity of video content, which can improve their viewing experience and increase their loyalty to the platform. In order to explore the performance of the instant music video intelligent recommendation algorithm based on augmented reality interaction in promoting user satisfaction and stickiness, the effectiveness would be verified through comparative experiments. Finally, the experiments showed that the instant music video intelligent recommendation algorithm based on augmented reality interaction had good results in content recommendation accuracy, diversity, and user satisfaction.

2. Augmented Reality Interaction Methods

(1) Video feature extraction

The video feature extraction results are shown in Figure 1. Here, one frame of a randomly selected video was extracted for color, texture, and shape feature points extraction. The video image in the upper left corner of Figure 1 is a randomly selected video obtained by extracting one frame of image, while the upper right corner of Figure 1 extracts color features from the original video image. It can be seen that the feature number values of the red, green, and blue color channels have been extracted in the color feature histogram; in the upper left corner of Figure 1, the local binary patterns is used to extract the local texture of the video screen, and finally the local binary patterns texture feature extraction histogram is obtained through the extraction of the video screen texture; the upper right

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corner of Figure 1 is the shape feature histogram obtained by using the Regionprops function to extract the shape features of the original video screen. In the shape feature histogram, features are mainly extracted for the areal feature, edge feature and the heart rate of the ellipse with the same standard second-order centre-to-centre distance as the region.

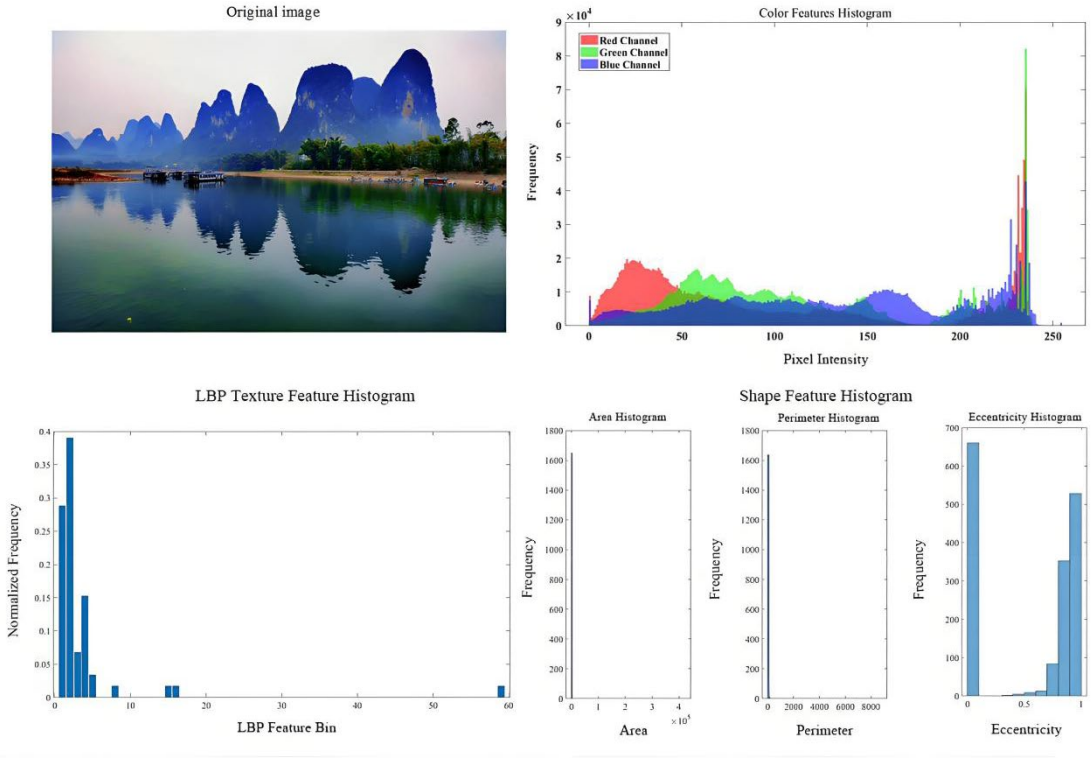

Figure 1 Video feature extraction

(2) User interest modeling

In order to better match users' interests and hobbies using intelligent recommendation algorithms, the types of instant music video are classified here, and an n-dimensional feature vector of user interests and hobbies can be formed. The formula is as follows:

$$y = \{x_1, x_2, x_3, \ldots, x_n\} \tag{1}$$

It is necessary to collect user viewing records, likes, shares, and other information, and store them in a database. This data can come from the instant music video platform's backend management system or other relevant data sources. Through the collected data, various user interest and hobby labels are classified and given corresponding weights. Here, each user would be treated as a training sample. By using the AdaBoost (Adaptive Boosting) algorithm in machine learning algorithms to classify various labels, it is a widely used technique that combines a group of weaker classifiers to construct stronger ensemble classifiers [9-10]. Firstly, the weight distribution of the initialized sample data is as follows:

$$D_1 = \{y_{11}, y_{12}, y_{13}, \ldots, y_{1i}\}\ , y_{1i} = \frac{1}{N}\ , i = 1,2,3,\ldots,N \tag{2}$$

Based on the weights of the above training samples, multiple iterations are performed, and i=1,2,...m is used to represent the number of iterations. After m iterations, a training sample data learning set D_m with weight distribution was obtained, resulting in the basic classifier.

$$T_m(x): x \to \{-1, +1\} \tag{3}$$

The classification error rate of $T_m(x)$ on the training sample dataset is calculated:

$$G_m = P(T_m(x_i) \neq y_i) = \sum_{i=1}^{N} y_{mi} I\ (T_m(x_i) \neq y_i) \tag{4}$$

The coefficient of $T_m(x)$ is calculated, and ID represents the importance of $T_m(x)$ in the final classifier:

$$ID_m = \frac{1}{2} log\ \frac{1-G_m}{G_m} \tag{5}$$

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The weight distribution of the training sample dataset is updated:

$$D_{m+1} = \{y_{m+1,1}, y_{m+1,2}, y_{m+1,3}, \cdot y_{m+1,i} \cdots, y_{m+1,N}\} \tag{6}$$

$$y_{m+1,i} = \frac{y_{mi}}{Z_m} exp(-ID_m y_i T_m(x)), i = 1,2,3,\ldots,N \tag{7}$$

In Formula 7, Z_m is the normalization factor. Through continuous iterative processes, samples that are misclassified by the basic classifier $T_m(x)$ are given higher weights in subsequent learning processes. The samples that are correctly classified receive lower weights, which enables the AdaBoost algorithm to pay more attention to instant music video user tags that are difficult to classify. Finally, each weak classifier is combined again. The formula is as follows:

$$f(x) = \sum_{m=1}^{M} ID_m \, T_m(x) \tag{8}$$

The final classifier can be obtained by combining the steps of weak classifiers using Formula 8:

$$T(x) = sign(f(x)) = sign(\sum_{m=1}^{M} ID_m \, T_m(x)\,) \tag{9}$$

(3) Similarity calculation

In the continuous development of multimedia technology today, recommendation systems can be an effective means to help users discover interesting content. It can help users quickly obtain their needs based on their preferences in a massive amount of information without wasting time [11-12]. Content based recommendation system is a common recommendation algorithm. Its core idea is to consider users and videos as points in vector space, and recommend the most relevant videos to users by calculating the similarity between these points. The specific operations when calculating the similarity score for each user are as follows:

First, the user's eigenvalues vector (assuming that there are n users) and the video's eigenvalues vector (assuming that there are m videos) are converted into points in the vector space. The similarity score between user u and video v is calculated, and a common method is to use cosine similarity, which calculates the cosine value of the angle between two vectors. The calculation formula is as follows:

$$Sim(u,v) = Cos(w_u, w_v) = \frac{\sum_1^k e_{1i} e_{2i}}{\sqrt{\sum_1^k {e_{1i}}^2} \sqrt{\sum_1^k {e_{2i}}^2}} \tag{10}$$

In Formula 10, e_{1i} represents the score of the i-th feature of user u and video v. For any user u and video v, the similarity scores between them are added to obtain a comprehensive score. The ultimate goal is to find the users and video pairs with the highest comprehensive score, which is the recommendation result.

If the recommendation is based on the collaborative filtering algorithm, a huge "user video" rating matrix needs to be maintained first, as shown in Table 1. Simply maintaining this table would occupy a large amount of memory space. Assuming that the rating data takes up 2 bytes, the memory space occupied by the table with 5000 users and 5000 instant music video is already very large. Currently, the number of users and instant music video on the instant music video platform far exceeds this number.

Table 1 "User Video" rating matrix

User Video	Video-1	Video-2	Video-3	...	Video-M
User-1	8	6	4	...	6
User-2	6	4	7	...	4
User-3	5	7	5	...	8
...	...	...	...	...	...
User-N	4	7	2	...	6

The "user video" rating matrix recommended based on the algorithm of collaborative filtering is shown in Table 1. It can be seen that in Table 1, different scores are given for the similarity calculation of various instant music video faced by each instant music video platform user. When the score reaches 7 or more, it indicates that the instant music video has a high matching degree for the user. In short, the video is in line with the instant music video topics that the user is interested in.

(4) Augmented reality interaction

Augmented reality is a rapidly developing field of Interaction design. It changes people's perception of real world images by overlaying digital data on real world images. It allows seamless integration of

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virtual content and display of real world scenes [13-14]. By utilizing augmented reality technology, recommended instant music video can be presented in the form of virtual objects in the user's real environment. By doing so, users can have a more intuitive understanding of the recommended video content and better judge whether they are interested and watch it. Specifically, this can be achieved through the following steps:

Firstly, in the user's real environment, a virtual camera or sensor is added to capture the user's environmental information. When a user opens a recommendation application, the system would generate a set of recommended instant music video based on their browsing history, interest preferences, and other information.

These instant music video are converted into virtual objects and placed in the user's real environment. These virtual objects can be in the form of images, videos, or animations.

When users interact with virtual objects, such as clicking, sliding, or rotating, the system would record the user's feedback information and use it to optimize recommendation algorithms.

Finally, based on user feedback, the system can further optimize the recommendation algorithm, such as adjusting its parameters and adding new recommendation content.

In this way, recommendation algorithms can be adjusted based on real-time feedback from users, further improving the accuracy and personalization of recommendations. Meanwhile, augmented reality interaction can provide users with a richer and more interesting viewing experience, increasing user stickiness and usage frequency.

3. Evaluation of the Effectiveness of Augmented Reality Interaction Methods

At present, instant music video, as a new form of content dissemination, has gradually changed the way people obtain information [15]. With the popularization of mobile internet and smartphones, instant music video has rapidly developed and become a new entertainment method and information dissemination channel. In the context of traditional multimedia, instant music video recommendations face issues such as information overload and inaccurate user interests. In order to improve the instant music video intelligent recommendation algorithm and provide more accurate and personalized recommendation services, augmented reality interaction methods can be adopted. Specifically, augmented reality interaction methods can provide users with a more intuitive and vivid viewing experience by combining virtual objects with their real environment. At the same time, this method can also collect real-time feedback information from users, thereby better understanding their interests and preferences, and improving the accuracy and personalization of recommendation algorithms. In order to verify the effectiveness of the augmented reality interaction method of instant music video intelligent recommendation algorithm technology in recommending more accurate instant music video content to users in the context of multimedia, the accuracy, recall, recommendation diversity, and user satisfaction of the recommendation algorithm were examined. The specific experimental data and results are shown below.

(1) Accuracy

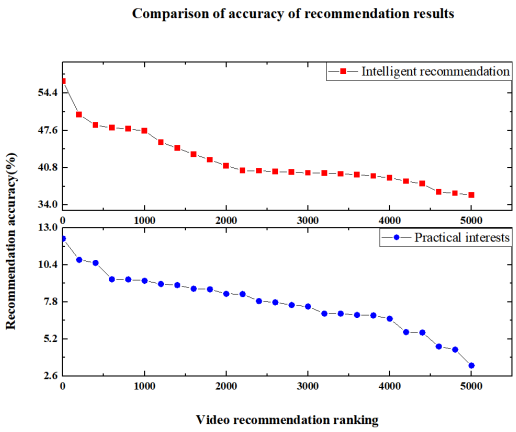

Figure 2 Recommended result accuracy

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In the evaluation of the effectiveness of augmented reality interaction methods based on intelligent recommendation algorithms, accuracy is a very important indicator. In augmented reality interaction methods, the accuracy of recommendation algorithms has a significant impact on user experience and effectiveness evaluation. If the accuracy of the recommendation algorithm is high, users can obtain more personalized and accurate recommendation content, thereby improving user satisfaction and user experience. On the contrary, if the accuracy of the recommendation algorithm is low, users may see uninterested content or incorrect recommendations, leading to user churn and dissatisfaction. In order to verify the recommendation accuracy of the augmented reality interaction method based on intelligent recommendation algorithms, in the evaluation experiment of the effectiveness of the augmented reality interaction method based on intelligent recommendation algorithms, the accuracy of the recommendation results was calculated by comparing it with the actual interests of users. The specific experimental results are shown in Figure 2.

Table 2 Analysis of experimental data on the accuracy of recommended results

Statistics type	Video recommendation ranking					
	Intelligent recommendation			Practical interests		
	0-1000	1001-3000	3001-5000	0-1000	1001-3000	3001-5000
Min accuracy(%)	47.47	39.82	35.78	9.29	7.48	3.33
Max accuracy(%)	56.56	45.45	39.79	12.25	9.06	6.98
Average accuracy(%)	49.83	41.68	38.16	10.27	8.29	5.81
Total	42.21			7.79		

The accuracy of the recommendation results of the augmented reality interaction method for intelligent recommendation algorithms is shown in Figure 2 and Table 2. This comparative experiment examined the accuracy of user video content recommendation results, and selected instant music video with recommendation rankings ranging from 0 to 5000 in the comparative experiment. From Figure 2, it could be seen that the overall accuracy of user video content recommendation results based on the intelligent recommendation algorithm's augmented reality interaction method exceeded 34%, while the accuracy of actual interest video recommendation results for users who did not use the intelligent recommendation algorithm was generally lower than 13%. Looking at the experimental data in Table 2, the augmented reality interaction method based on intelligent recommendation algorithms had the highest accuracy among all instant music video in instant music video recommendation rankings of 0-1000. The highest accuracy rate of recommendation results reached 56.56%, while the lowest accuracy rate of recommendation results was 47.47%. The average recommendation accuracy for this ranking range was 49.83%; the instant music video recommendation ranking from 1001 to 3000 had the highest accuracy rate of 45.45%, while the lowest accuracy rate was 39.82%. The average accuracy rate of recommendation results in this ranking range was 41.68%; the accuracy of recommendation results with instant music video recommendation rankings of 3001-5000 was the lowest among all instant music video, with the highest accuracy of 39.79% and the lowest accuracy of 35.78%. The average accuracy of recommendation results in this ranking range was 38.16%. Based on the above experimental data, it could be concluded that the average accuracy of user video content recommendation results based on the intelligent recommendation algorithm's augmented reality interaction method was 42.21%. Looking at the actual accuracy of video recommendation results for users who did not use intelligent recommendation algorithms, the instant music video recommendation ranking of 0-1000 had the highest accuracy among all instant music video, with the highest recommendation accuracy reaching 12.25% and the lowest recommendation accuracy being 9.29%. The average recommendation accuracy in this ranking range was 10.27%; the highest accuracy rate of recommendation results for instant music video recommendations ranging from 1001 to 3000 was 9.06%, while the lowest accuracy rate was 7.48%. The average accuracy rate of recommendation results in this ranking range was 8.29%; the instant music video recommendation ranking of 3001-5000 had the lowest accuracy among all instant music video, with the highest recommendation accuracy of 6.98% and the lowest recommendation accuracy of 3.33%. The average recommendation accuracy within this ranking range was 5.81%. In summary, users who did not use intelligent recommendation algorithms had an average accuracy of 7.79% in actual fun video recommendation results.

(2) Recall rate

Recall rate is a commonly used indicator in evaluating the effectiveness of augmented reality interaction methods based on intelligent recommendation algorithms. If the recall rate of the recommendation algorithm is high, it indicates that it can find more video content related to user interests, and the quality of these video content is also relatively high, thereby improving user satisfaction and user experience. On the contrary, if the recall rate of the recommendation algorithm is low, it indicates that it may have missed detections or misjudgments, resulting in users not being able to

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obtain satisfactory recommendation results, thereby reducing the user experience and effectiveness evaluation. In order to verify the coverage of user interest in the augmented reality interaction method based on intelligent recommendation algorithms, in the evaluation experiment of recall rate, the coverage performance of user interest in the two schemes was explored by comparing the results with those without recommendation algorithms. The specific experimental results are shown in Figure 3.

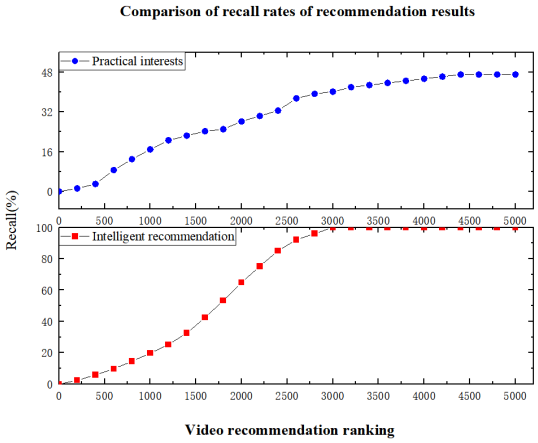
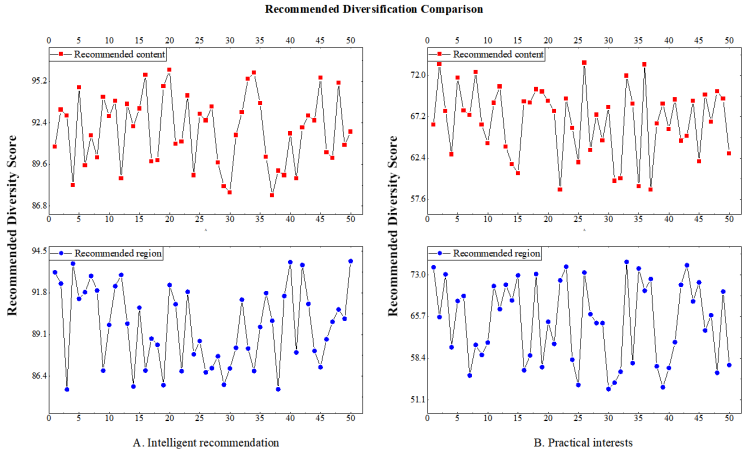


Figure 3 Recommended algorithm recall rate

The experimental results of the recall rate of the intelligent recommendation algorithm for augmented reality interaction methods are shown in Figure 3. This comparative experiment examined the recall rate of the recommendation algorithm, and also selected instant music video with recommendation rankings ranging from 0 to 5000 in the comparative experiment. From Figure 3, it could be seen from the experimental results that the recall rate increased with the increase of the window. Based on the intelligent recommendation algorithm, it was fully filled and reached the maximum value of 100% when the test set reached 3000. This indicated that the intelligent recommendation algorithm had a very high coverage of user interests and could meet the viewing needs of all different types of instant music video users.

(3) Recommendation diversity



A. Recommendation diversity based on intelligent recommendation algorithms
B. Recommendation diversity based on user's actual interests

Figure 4 Recommended diversity

When evaluating the effectiveness of augmented reality interaction methods based on intelligent recommendation algorithms, it is very important to examine the significance of recommendation diversity. Recommendation diversity refers to the ability of a system to provide users with a variety of different recommendation content or choices to meet the needs and preferences of different users. Specifically, recommendation diversity can help improve user experience and satisfaction. This is because it can avoid the recommendation content of recommendation algorithms being too uniform, causing users to feel bored and uninteresting. In addition, recommendation diversity can also promote

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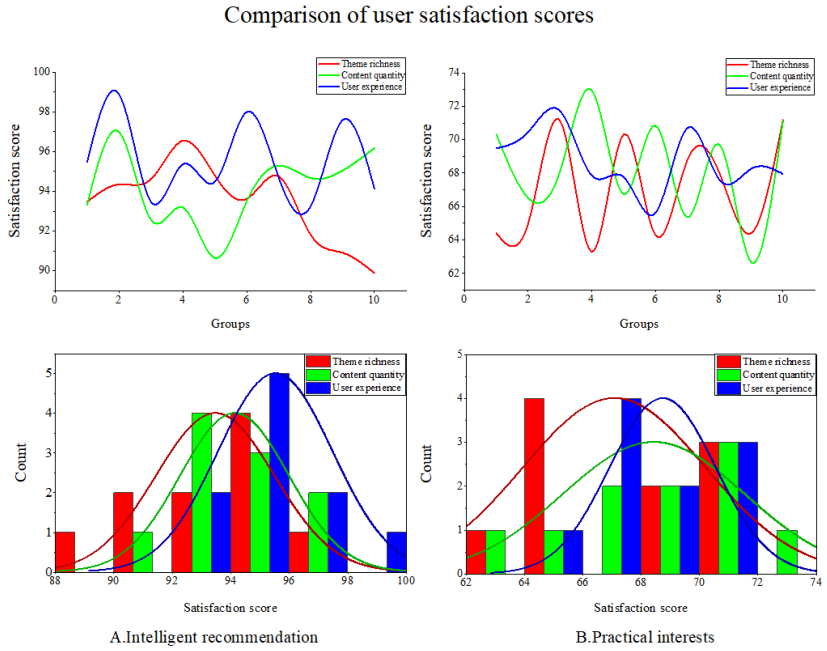
user exploration and discovery, thereby increasing their engagement and loyalty. In order to verify the recommendation diversity of augmented reality interaction methods based on intelligent recommendation algorithms, in the experiment of evaluating recommendation diversity, 50 users were randomly invited to rate the recommendation diversity, and a comparison experiment was conducted with the actual interests of users who did not use intelligent recommendation algorithms. The specific experimental results are shown in Figure 4.

The comparative experimental results of recommended diversity under the two schemes are shown in Figure 4A and Figure 4B. This comparative experiment examined the diversity of recommendation content and recommendation regions. In a comparative experiment, 50 users were randomly invited to rate the diversity of recommendations. From Figure 4A, it could be seen that the overall recommendation content diversity of the augmented reality interaction method based on intelligent recommendation algorithms exceeded 87%, and the overall recommendation regional diversity score exceeded 85 points; from Figure 4B, it could be seen that users who did not use intelligent recommendation algorithms generally scored lower than 74 points for the diversity of recommended content in their actual interest videos, and the overall score for the diversity of recommended regions was lower than 76 points. The recommended content diversity score of the augmented reality interaction method based on intelligent recommendation algorithms reached the highest of 95.97 points, while the recommended content diversity score reached the lowest of 87.51 points. The average recommended content diversity score obtained from all 50 experiments was 91.86 points; the highest recommended regional diversity score was 93.85 points, while the lowest recommended regional diversity score was 85.54 points.

(4) User satisfaction

User satisfaction is a reference condition for measuring whether a product or service meets design indicators or customer needs. If users are not satisfied with augmented reality interaction methods based on intelligent recommendation algorithms, they may choose to give up using the product or service, thereby affecting the market competitiveness and commercial value of the product. In order to verify the user satisfaction of the augmented reality interaction method based on intelligent recommendation algorithms, 60 users were randomly selected and distributed a satisfaction questionnaire to evaluate their satisfaction with the recommendation results. The user satisfaction survey results are shown in Figure 5.



A. User satisfaction survey based on intelligent recommendation algorithm
B. User satisfaction survey based on actual interests

Figure 5 Comparison of user satisfaction surveys

The results of the comparative experiment on recommendation diversity under two schemes are

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shown in Figures 5A and 5B. The comparative experiment examined the user satisfaction survey and randomly invited 60 users to rate their satisfaction. From Figure 5A, it could be seen that based on the intelligent recommendation algorithm, the overall scores of topic richness, content quantity, and user experience in the user satisfaction survey exceeded 89 points; from Figure 5B, it could be seen that users who did not use intelligent recommendation algorithms generally scored lower than 74 points in terms of the richness of their actual interests, content quantity, and user experience. The theme richness score based on intelligent recommendation algorithm reached the highest of 96.54 points, while the theme richness score was the lowest of 89.89 points. The average theme richness score obtained from all 10 experiments was 93.48 points; the highest score for content quantity was 96.99 points, while the lowest score for content quantity was 90.65 points.

4. Conclusions

Through the above experimental analysis, it can be concluded that in the exploration of the accuracy of instant music video recommendations, the instant music video content recommendation scheme based on intelligent recommendation algorithms can effectively improve the accuracy of user content recommendations compared to the actual interest scheme of users who do not use intelligent recommendation algorithms. The instant music video content recommendation scheme based on intelligent recommendation algorithms analyzes user historical behavior data, establishes a user interest model, including user viewing records, likes, shares, and other information, and uses machine learning algorithms for modeling. According to the video characteristics and user interest model, the similarity between videos is calculated. The method of combining content-based recommendation algorithm and collaborative filtering algorithm is adopted to comprehensively consider the content similarity and user interest similarity of videos. In order to verify the effectiveness of instant music video content recommendation schemes based on intelligent recommendation algorithms, comparative experiments were conducted here with user actual interest schemes that did not use intelligent recommendation algorithms. This comparative experiment examined four evaluation indicators: recommendation accuracy, recall rate, recommendation diversity, and user satisfaction. The final experimental results indicated that the instant music video content recommendation scheme based on intelligent recommendation algorithms not only had high accuracy and recommendation diversity in instant music video recommendation, but also had high user satisfaction.

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