The LIGHT EXPLORER
Pushing the limits of possibilities... unfolding the light of the truth

ISSN (Print): 2546 – 0102
ISSN (Online): 2423 – 3080
Vol. 8, No. 4, December 2023

Recommended citation:
Li, Y. (2023). Personalized Movie Recommendation System Based on Springboot Framework. *The Light Explorer*, *8*(4).

PERSONALIZED MOVIE RECOMMENDATION SYSTEM BASED ON SPRINGBOOT FRAMEWORK

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ABSTRACT

As an important element of culture and entertainment in today's society, movies are developing rapidly on the fast train of the Internet, but with the rapid growth of all kinds of data resources of movies, people can no longer get the movies they are interested in in a timely and efficient manner with the help of the Internet. To solve the problem of information overload caused by the surge of data, personalized recommendation technology has emerged. This paper focuses on the use of SpringBoot framework to quickly build a movie information management system, based on the user's collaborative filtering algorithm and the Pearson correlation coefficient to calculate the user's similarity, and finally on the system to visualize the movie information data and the user's personalized movie recommendation, so that the system can more effectively meet the user's needs.

Keywords: *collaborative filtering algorithms, data visualization, information overload, movie information systems, personalized movie recommendations*

INTRODUCTION

As a crucial element of today's social life, culture and entertainment, movies are developing rapidly on the express train of the Internet. More and more people choose to watch movies or watch movie introductions through the Internet, and gradually get used to accessing and browsing the latest movie information through the Internet, and exchange and feedback after the movie.

With the progress of computer technology and time, various kinds of film resources continue to accumulate. The film resources obtained by people through the network are too rich and of uneven quality, and they cannot find the movies they are interested in in a brief time, resulting in the phenomenon of information overload (Zhang et al., 2020). For movie-watching users, their preferences for movies are constantly changing over time, becoming increasingly personalized and diverse. Consequently, quickly, and accurately identifying movies that match users' interests has become a significant challenge (Zhang, 2020). For movie resource providers, it is also particularly important to manage and make effective use of movie information resources, improve user experience, increase user engagement, retain loyal users, improve ratings and

traffic, thereby increasing revenue and improving user satisfaction (Li, 2019). Collaborative filtering uses many existing user preferences to estimate the degree of preference for items a user has not interacted with. It can filter the user's preferences and feedback on the movies that have been watched, to locate the movies that the user is interested in in the massive movie data and make personalized movie recommendations for the user (Pavitha et al., 2022).

Zeng (2019) believes that the movie recommendation system applies collaborative filtering algorithms to proactively analyze user behaviors and recommend content that users are interested in, which improves user stickiness and experience and enables users to get the information they want faster. Targeted advertising for users to increase the probability of consumption of users, the company can obtain considerable advertising costs. Recommending products for users can increase the company's profit margin.

According to Zhang (2019), the movie recommendation system based on collaborative filtering algorithm can help users obtain the movies they want to watch from many movies, which is a typical application of big data in the Internet field. By analyzing users' historical viewing records, users can understand their preferences, and then actively recommend the movies they are interested in to meet users' personalized viewing needs.

Hou (2020) posits that the network will become the main source for users to obtain movies, and personalized movie recommendation that fuzzy user needs have more application prospects. The system based on collaborative filtering algorithm predicts the movies that meet the user's interest and love, accurately recommends the movies that meet the user's interest and love and obtains user trust and increases viscosity.

The movie recommendation system designed by Shi (2020) realizes the movie information management function and movie recommendation function. He believes that the system uses Douban movie data as a data set for movie recommendation, which ensures the availability of the system and the authenticity of the recommendation results.

Sun (2021), in his research on collaborative filtering recommendation algorithm integrating movie tags, can produce more personalized movie recommendation for users without historical viewing records, and effectively improve the accuracy for users with existing historical data.

Song et al. (2022) applied collaborative filtering algorithms in the movie recommendation system to save users' time in filtering movie information and meet users' individual needs. When the user does not have a clear request, the system will actively recommend the movie that the user is interested into the user through personalized calculation.

Hu (2022) states that for enterprises, the recommendation system is more like an algorithm tool to promote user growth, helping users to screen among complicated projects, reducing unnecessary information retrieval time, reducing the transaction cost of users to find and select goods, and improving user experience.

Shang (2022) believes that the recommendation system built by the user-based collaborative filtering algorithm interacts with the e-commerce platform to form a personalized recommendation list and displays product information to users in a specific way, which can effectively improve the trust of users and become an important measure to increase the purchase rate of consumers and enhance user viscosity.

Ye (2023) adopted the current popular Spring Boot framework to realize the search and personalized recommendation service of film and television content and used the recommendation algorithm to predict the film and television content that users might be interested in according to their behaviors. He believes that the system can quickly screen massive amounts of information to an acceptable amount according to users' needs, interests, habits, etc., so that users can quickly and accurately find the movie they want.

Wu et al. (2023) elaborate that by recommending movies that users will choose in the future, filtering information that they are not interested in, and shortening the time for users to search for movies, the recommendation technology will effectively improve users' attention to the system, enhance user satisfaction, increase movie ratings, and achieve the best of both worlds.

The recommendation algorithm adopted in the recommendation system developed and designed by Si et al. (2023) uses the most abundant and stable collaborative filtering algorithm in data mining to solve the problem of movie information overload and unclear user needs. Compared with using search engines, users can more easily obtain the movie information they are interested in, which makes the service more personalized.

Dadi Cinema Line, as a chain cinema organization based on cinemas in China, has about 60 million moviegoers in 2022, ranking first among Chinese cinema companies in terms of the number of cinemas, geographical distribution, and number of movie-going users. Dadi Cinema Line, as a commercial organization, directly serves the cooperation mode between commercial real estate partners and cinemas. However, film promotion has long neglected the consumer side and failed to meet and respond to the needs of users in a timely manner. In the face of the continuous development of the film market in recent years, cinemas are also in urgent need of promoting and promoting high-quality films, film information and pan-film products to users, while providing users with personalized movie services and recommendations to enhance the movie box office.

Aiming at the above problems and phenomena, this research developed a management system of movie information based on SpringBoot framework, applying user-based collaborative filtering algorithm to visualize data and realize personalized movie recommendation on the system. Through the system background management and portal information functions, the distance between the system and the user is brought closer to maximize the user experience, and at the same time, a more effective publicity of the movie viewing effect is carried out for the movie resource party to increase the user's trust and stickiness, promote the brand, and achieve the retention and attraction of new users, which in turn ultimately realizes the enhancement of the cinema's box office and improves the competitiveness of the cinema.

Statement of the Problem

The study aimed to design and develop a personalized movie recommendation system based on SpringBoot framework.

Specifically, the study sought answers to the following questions:

1. What are the problems and challenges that Dadi Cinema will encounter in the following aspects of the function of film resource management and recommendation?
2. What recommendation algorithms can be used to implement personalized movie recommendation?
3. What system can be developed to solve the problems and challenges encountered by Dadi Cinema Line?
4. What improvements can be made to enhance a personalized movie recommendation system based on the SpringBoot framework?

4.1. Functionality
4.2. Efficiency
4.3. Compatibility
4.4. Usability
4.5. Reliability
4.6. Security
4.7. Maintainability
4.8. Portability

5. What enhancements can be made to improve the developed system?

METHODOLOGY

Research Design

This study adopted descriptive survey as the research design, based on interviews and questionnaires to collect data related to the research, and then described the participants' evaluation of the functions and services provided by the system, and enhances the development of the system according to these studies. At the same time, the prototype model method is used in the development process to better understand user requirements and system functions, and to identify and solve potential problems at an early stage. This approach can help developers reduce the risk of developing software products that do not meet the needs of end users or stakeholders, understand the deadlines and milestones to meet the project, while also reducing development time and costs, promoting team collaboration and iterative development, and improving the quality of the final software product and user satisfaction. The prototype model development process consists of 11 stages: (1) requirements collection and analysis, (2) prototype design, (3) prototype production, (4) prototype evaluation, (5) prototype feedback, (6) design, (7) coding, (8) deployment, (9) testing, (10) system evaluation, and (11) system maintenance. Finally, once the system is operational online, any new customer demands or requests for updates to the system module will initiate the cycle again, starting from the first stage of the prototype model, leading to ongoing system iteration. In addition, the researcher used the ISO 25010 standard as a guide to develop a standard questionnaire, using a quality model to determine which quality characteristics to consider when evaluating a software product's characteristics.

Participants of the Study

The researchers carefully selected participants or subjects for the study, considering the critical role of IT experts in the system's implementation. These participants are categorized into the following groups:

User participants. This refers to the moviegoers, general users, catalogers and system administrators of the system who provided feedback on the current use of the system, will advised on problems and questions encountered during the implementation of the system, as well as features and data for the development of the system features, and also assessed the level of compliance of the developed system according to ISO 25010.

IT experts. IT experts are employed by the cinema chain and advised on the data, functions and non-functions of the system's functional development and assessed the level of compliance of the developed system according to ISO 25010.

The following table shows the distribution of study participants.

Table 1.
Distribution of Participants in the Study

Participants	Target Frequency	Percentage (%)
IT experts	10	15.38%
Users	40	61.54%
Moviegoers	10	15.38%
Cataloguers	3	4.62%
Administrators	2	3.08%
TOTAL	65	100.00%

Instrumentation

This study utilized the appropriate instrumentation to collect and interpret the data, as well as the tools or means employed: interviews, ISO standard questionnaires, etc. The researchers used a 5-point Likert scale questionnaire and analysis results to determine the level of compliance of the development system to the ISO 25010 software quality standard. The instrument was divided into eight dimensions, namely: (1) Functionality, (2) Efficiency, (3) Compatibility, (4) Usability, (5) Reliability, (6) Security, (7) Maintainability, and (8) Portability. The following are the levels used as guidelines for evaluating the acceptability level of the system: 4.20-5.00 Very Great Extent, 3.40-4.19 Great Extent, 2.60-3.39 Moderate Extent, 1.80-2.59 Little Extent and 1.00-1.79 Very Little Extent.

Interview. The researcher conducted an interview with moviegoers, ordinary users, and

administrators about the problems, issues, and challenges of the system's different processes and operations.

Questionnaire survey. The researcher used a 5-point Likert scale tool to issue questionnaires to study participants to determine the level of compliance of the development system to the ISO 25010 software quality standard.

Review of Documents. The documents were analyzed and studied carefully by the researcher for better understanding and to further furnish necessary ideas which will give more valuable information on the different functional parts of the system.

Data Gathering Procedure

The data collection program covers a series of steps and methods from designing data collection tools to collecting data.

1. The researcher obtained clearance from the SPUP REC to ensure the accuracy, reliability and validity of the data, and compliance with ethical and legal requirements.
2. After obtaining clearance from the Ethics Review Committee, the researcher sought endorsement from the Dissertation adviser and the Dean of the Graduate School for data gathering.
3. Before conducting the survey, the researcher sought for permission from cinema operators to collect data about the film. Interviews are conducted with Dadi cinema executives, moviegoers and researchers, and the cinema received a questionnaire.
4. The collected questionnaires were organized, counted, tabulated, and summarized in preparation for statistical analysis and interpretation. Summaries of interviews with film administrators and catalogers, as well as interviews with film audiences, served as the basis for the system's initial requirements.
5. In order to collect documents and data related to the study, the survey tools in the instrument were distributed to the participants.
6. The researcher prioritized data privacy by preserving the anonymity and confidentiality of the information. This was accomplished by regulating data access, ensuring data security, and managing data disposal appropriately.

Data Analysis

Through the data acquired in the data collection program, this study conducted statistics and analysis on the data and presented and explained it. Two statistical tools were used here.

Frequency and Percentage. These tools were used to obtain the opinions of research participants on the problems encountered in the existing system, which helped classify participants.

Weighted Mean/Average. This tool is used in this study to calculate the evaluations of study participants to reflect the corresponding quality level of evaluations.

Likert Scale. This scale was used for scoring and describing participants' responses in this study.

Table 2.

Scale for Interpreting the Assessment of the Participants on the Extent of Compliance of the Developed System to ISO 25010 Software Quality Standards.

Numerical Rating	Arithmetic Mean Ranges	Interpretation
5	4.20 – 5.00	Very Great Extent
4	3.40 – 4.19	Great Extent
3	2.60 – 3.39	Moderate Extent
2	1.80 – 2.59	Little Extent
1	1.00 – 1.79	Very Little Extent

RESULTS AND DISCUSSION

This section presents the results of the interviews and questionnaires, as well as the IT experts' evaluation of their developed Personalized Movie Recommendation Systems (PMRS) using the ISO 25010 software quality standard. In the process of presenting relevant content, it will be introduced,

analyzed and explained in the order in which the problem is presented.

1. Problems, Issues, and Challenges of the PMRS.

Through systematic and in-depth interviews, questionnaires and document reviews, the researchers identified the following issues, problems and challenges that Dadi Cinema has encountered:

The current online system of Dadi Cinema Line serves only as a general publicity platform for movies, news, and enterprise information, presenting the same content to all users. It lacks personalization features, such as user registration and permission controls. As a result, Dadi Cinema Line managers face challenges in managing movie information effectively according to business needs and in safeguarding user privacy and data. The system's absence of authorization limits their ability to tailor content and understand users' classification and movie consumption preferences. However, the movie audience cannot register and log in the system, and then search and pay attention to their favorite movies, which is reflected in:

(1) There are deficiencies in the collection and sorting of movie data and other unreleased movie data in the existing system. For example, managers will not classify and collect movies that have been released, and they will not pay attention to and collect movies that have not been released in theaters. In addition, users cannot view historical movie information.

(2) The management functions of the current system, such as movie information, user labels, ratings and browsing history, are imperfect or lacking. For example, the information reflecting multiple attributes of the film is not rich enough; Lack of user tags that reflect the preferences of different types of users; It does not support user ratings and reviews of movies, and it is difficult for managers to collect user feedback on the release of movies and understand the popularity of various categories of movies; Without a history of movies that users have viewed, it's hard to find the most-trafficked movies.

(3) The existing system of movie listings and personalized movie recommendations and other functions are missing. For example, there is no movie list recommendation, and it is impossible to recommend their preferred movies to users.

(4) The existing system does not provide data visualization analysis functions. For example, Top N movie views, Top N movie collections, and the user's favorite type of movie labels.

2. Recommendation Algorithms.

Recommendation technology is a kind of technology that provides users with personalized, accurate and valuable recommendation content by analyzing user behavior, content characteristics and other relevant information. Recommendation algorithm is a specific component of recommendation technology. It refers to a mathematical and statistical model used to predict the content or project that users may like based on their interests, historical behaviors, social relations, and other information, and is a specific implementation of recommendation technology.

Collaborative Filtering is a recommendation algorithm model based on user behavior history that uses similarities between users and items to predict what items users are likely to like. Collaborative filtering is divided into two methods: item-based and user-based. Item-based collaborative filtering (Item-CF) recommends items that users like based on their similarities, achieving the effect of "birds of a feather flock together." User-based collaborative filtering (USER-CF) finds other users with similar behaviors to the target User, and then recommends the items that these users like to the target user, achieving the effect of "people by group".

To better identify similar items or similar users, common similarity algorithms for similarity calculation in collaborative filtering are:

Cosine Similarity. Cosine similarity represents the degree of acquaintance of users with the cosine Angle, and its value interval is [-1,1]. When the algorithm result is closer to 1, the similarity between users is higher; when the algorithm result is closer to -1, the similarity between users is lower.

Pearson Correlation Coefficient. Pearson correlation coefficient is based on the intersection of behavioral preferences between users to measure the similarity relationship between users. Compared with cosine similarity, Pearson correlation coefficient corrects each independent score through the average score of users, thereby reducing the impact of user score bias.

Cao et al. (2019) analyzed the historical data of users of "Ningbo Metro go" by using the item-based collaborative filtering algorithm, mined the correlation among users' items, introduced the price weight of items, and realized the recommendation of products preferred by users.

Yu et al. (2022) analyzed the historical rating behavior of users through the user-based collaborative filtering algorithm to find out the groups with similar hobbies and analyzed the groups with similar users through Pearson similarity. Finally, the consumer has not seen the movie score forecast, and find a high forecast score of the movie to recommend.

Luo et al. (2023) conducted movie recommendation experiments on user-based collaborative filtering algorithms and project-based collaborative filtering algorithms respectively under the same conditions, from the perspective that the number of users is larger than the number of projects and the number of users is smaller than the number of projects. The experiments show that the two algorithms have their own characteristics, and the project-based collaborative filtering algorithm has higher quality from the perspective of accuracy. From the perspective of time cost, the user-based collaborative filtering algorithm is more efficient, and the corresponding algorithm should be selected in different scenarios.

This study considered the running time cost of system recommendation, adopts a user-based collaborative filtering algorithm, and uses Pearson Correlation Coefficient to calculate the similarity of users, and then recommends their preferred movies to users.

3. Developed PMRS

This development system is a movie information management system based on SpringBoot framework. Based on the existing movie data in the system, it is helpful to provide Dadi cinemas with integrated management and data visualization functions of movie, user, label, theater, and news information. It is a movie portal system that allows users to browse movie information online, view movie charts, search movies, understand and evaluate movies, and give feedback and suggestions. In addition, it is also a personalized movie recommendation system, which is based on user movie rating data, and applies user-based collaborative filtering algorithms to recommend movies of interest and preference to similar users. The system and data developed in this research are conducive to the movie management and business management decisions of theater managers, to promote the interaction between theater lines and users, and to improve the brand reputation of theater lines.

This development system (PMRS) includes two parts: portal and background management. The portal is accessible to movie audiences and ordinary users, while the back-office management is used by Dadi Cinema Line managers.

3.1 Portal Interface

The functions of the portal interface include the portal home page, movie list, hot movies, theaters, news, and feedback functions.

Figure 1

Home page of the portal Interface

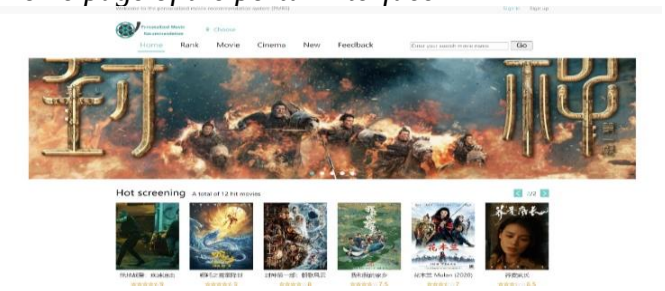


Figure 1 shows the interface of the portal home page. On the home page of the portal, the information of popular movies, promotional films, hot news, popular theaters and the Top 5 movies at the box office are concentrated for publicity and display. Users can quickly understand the main information of the movies through the pictures, text and videos that are broadcast on the portal interface.

Figure 2

Movie Rank Interface

Figure 2 shows the movie list interface of the portal. In the movie list, priority is given to showing users movies with high ratings and high traffic. In the high rating category, movies with the highest user ratings are ranked at the top. In the high traffic category, movies with the most views by users are positioned at the top of the list.

Figure 3

Recommended Movie Interface

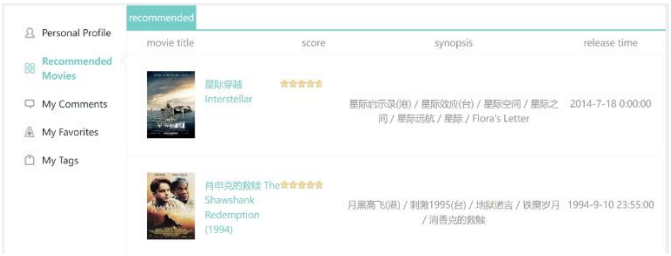


Figure 3 illustrates the movie interface that the system makes personalized recommendation to users. This function does not require users to actively find and filter the movies they want, and the system will recommend their preferred movies to users according to the user-based collaborative filtering algorithm and give the main information such as the title of the movie, stills, ratings, and release dates for users to browse.

Figure 4

User-CF Recommended Result Background output

```
Adjacent user ID: 8, Similarity: 0.0
Adjacent user ID: 7, Similarity: 0.0
Adjacent user ID: 2, Similarity: 0.9999999999999998
Adjacent user ID: 3, Similarity: 0.9999999999999998
Adjacent user ID: 11, Similarity: 1.0
For User ID: 13, Number of recommended movies: 10, Movie ID list: [16, 1, 6, 17, 2, 3, 35, 4, 22, 8]
```

Figure 4 presents the background data interface of the system recommending movies to the current user based on user similarity. Through the collaborative filtering algorithm of users, the system background calculates the similarity of users by using Pearson correlation coefficient and recommends the movies that similar users like to users. In this interface, 5 nearby similar user IDs are found for the current user ID 13, and the similarity score of each user is given. Among them, the user with the user ID 11 has the similarity 1.0 and likes the same movie; the user with the user ID 2 and 3 has the similarity greater than 0.99, reaching an exceedingly high similarity. At the same time, the system background gives a list of movie ids from high to low ratings for similar users' favorite movies.

3.2 Background Management

Background management functions include the background home page, data analysis, movie management, theater management, news management, feedback management, label

management, regional management, user management and system settings.

Figure 5

Backstage Home Interface

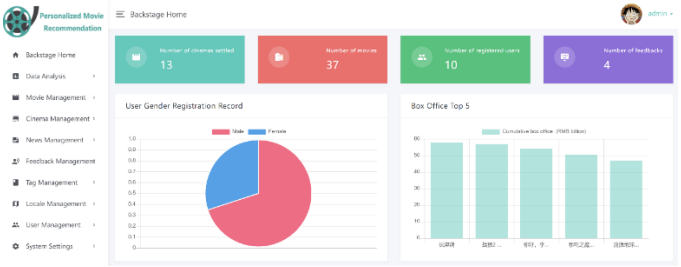
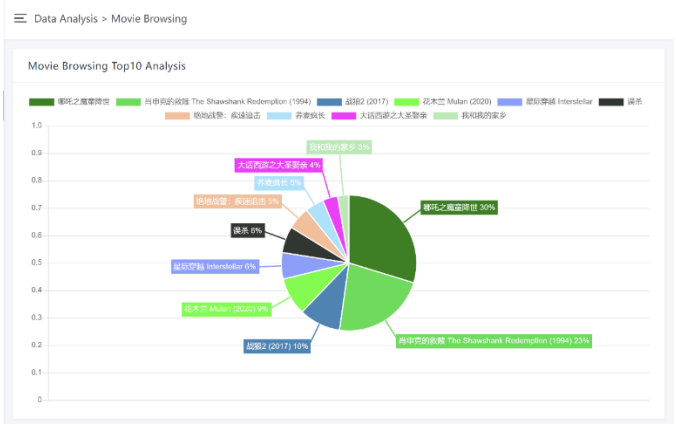


Figure 5 shows the interface of the background home page. In this interface, managers can visually view the number of theaters, the number of movies, the number of portal users registered, and the number of user feedback collected by the system portal. At the same time, the system displays the portal users' gender distribution and the Top 5 movie box office information in the form of pie charts and bar charts.

Figure 6

Movie Browsing Top10 Interface



Data analysis function. Graphically display including the number of movie views, the label category of the movie and the collection of the movie, which is convenient for managers to visually view. Figure 6 shows the screen for movie views. This interface uses pie charts to visually display the top 10 most-viewed movies, and users can also view the total number and proportion of movies viewed.

4. PMRS Extent of Compliance with ISO 25010 Criteria

The ISO 25010 standard objectively measures the level of quality and satisfaction of the system by evaluating various aspects of the developed system and obtaining the score or degree of compliance of the system under each quality characteristic. Here, using a 5-point Likert scale questionnaire and analysis, the distribution of feedback from IT experts were constructed into a series of tables to clearly display all the collected data, and an evaluation summary table was formed after sub-evaluation of various quality characteristics of the developed system.

Table 3.

Summary of Evaluation of the System's Compliance with the ISO 25010 Criteria

ISO 25010 Characteristics Criteria	Criteria Mean	Descriptive Rating
A. Functional Suitability	4.57	Very Great Extent
B. Performance Efficiency	4.23	Very Great Extent
C. Compatibility	4.35	Very Great Extent
D. Usability	4.55	Very Great Extent
E. Reliability	4.30	Very Great Extent
F. Security	4.38	Very Great Extent
G. Maintainability	4.20	Very Great Extent
H. Portability	4.37	Very Great Extent
Overall Mean	4.37	Very Great Extent

Table 3 shows a summary of the assessment of the degree to which the developed system conforms to ISO 25010.

The evaluation results showed that the developed system achieved an overall average of 4.37, which is described as a "Very Great Extent" of

compliance. The table also shows that functional suitability and usability are the two most highly rated criteria out of the eight ISO 25010 features, with an average of 4.57 and 4.55 respectively, both described as having a "Very Great Extent" of compliance. This was followed by other criteria, in the following order: security, portability, compatibility, reliability, performance efficiency, and maintainability, with averages of 4.38, 4.37, 4.35, 4.30, 4.23, and 4.20, respectively, all indicating a "Very Great Extent" of compliance.

5. Recommended Enhancements for the Developed PMRS

Movie recommendation function. As an enhancement function of the system, the recommendation function will improve the user experience and the efficiency of users to obtain favorite movies. Based on the user's movie history rating, evaluation and browsing, the system generates a movie recommendation list according to the user's movie rating, and provides users with movies that they may be interested in. This feature reduces the user's search time in many movies. For example, when users log in to the system to enter the movie recommendation module, the system will automatically recommend their preferred movie list, saving the user's waiting time and meeting the user's personalized needs in the movie

Data visualization analysis. This feature helps managers quickly understand current theater occupancy, movie registrations, portal user registrations and the number of user feedback collected by the portal, as well as movie data. For example, the system visually displays the top 10 movie views, movie label classification, movie collection Top10 and movie box office Top5 functions to managers in the form of pie charts or bar charts, which will improve the ease of use and usability of the system backstage.

Movie user tag. Due to the lack of movie classification and labeling in the current system, it is difficult for users to find specific movies. By introducing movie user labels, the system can more accurately classify movies in multiple dimensions, and each user can have their own favorite type of movie label. This will help the system to manage movie resources more flexibly and improve the availability of the entire system.

Movie browsing history. The current system does not have the function of recording the movies viewed by users, so it is difficult for the management personnel to find the movies with heavy traffic. By adding the movie viewing record function, each viewing situation of a movie is recorded and the number of records of each movie is generated, thus forming a function of movie list recommendation, such as the Top 20 movie list, to help users quickly obtain movies with high traffic. From improving system availability.

CONCLUSION

The developed system will function as an effective information management tool for film data. Movie audiences can easily browse and search for movie information, view rankings, and evaluate films. Ordinary users can collect their favorite movies and receive automatic recommendations from the system. For managers, the system offers efficient management capabilities for movies, users, theaters, news, and other related information. Additionally, the system's data visualization features and regular collection of movie and user data will support theater managers in making informed business decisions and managing operations effectively. The system portal will also enhance interaction between theaters and users, contributing to improved brand reputation for theaters.

RECOMMEDATION/S

Based on the findings and conclusions, the researcher recommends the following:

1. The researcher should submit the developed system to the management staff of Dadi Cinema Chain and movie audiences for use, to achieve efficient management and promotion of movie information.

2. The system's management personnel should be trained on the system's use before its implementation, so they can use it correctly.
3. Future researchers should further expand the sample size of movie data, increase the attributes that affect the effect of recommended movies, build, or improve the recommendation algorithm model by comparing and using more suitable machine learning algorithms, and improve the accuracy of personalized movie recommendation.

Acknowledgments

Words cannot express my gratitude to my professor, the chair of the defense panel, and panel members for their invaluable patience and feedback.

I am also grateful to my colleagues and the friends I met along the way for their support, advice and help to make this journey fulfilling and interesting.

Lastly, I would like to thank my family, especially my parents, spouse and children, whose trust and love for me is what keeps my spirits high and motivated.

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