Research on recommendation algorithm based on user sentiment analysis

Yuan Gong

Shengtong Intelligent Technology (Beijing) Co., Ltd. Beijing 100176, China

15222588166@163.com

Abstract. With the development of Internet technology, the recommendation system is becoming an essential part of major e-commerce platforms, social media platforms and other application fields. The main purpose of the recommendation algorithm is to provide users with personalized and accurate recommendations of goods, services and information. Traditional recommendation algorithms are mainly based on information such as users' historical behavior to recommend similar items to users. However, only considering the historical behavior of users cannot fully reflect the individual needs of users because the emotions and interests of users are dynamic. Therefore, introducing user emotion is an important direction of a personalized recommendation system. Based on user emotional analysis,a recommendation algorithm aims to understand user preferences and interests by analyzing their emotional reactions. It utilizes emotional data to generate personalized recommendations, considering the sentimental factors that influence consumer purchasing decisions. By incorporating emotional intelligence into the recommendation process, this algorithm aims to improve the accuracy and effectiveness of product suggestions, ultimately enhancing user satisfaction. This paper will discuss the introduction of the user emotion recommendation algorithm and explore its implementation and application scenarios.

Keywords: Recommendation Algorithm, User Emotion, Machine Learning, Deep Learning.

1. Introduction

The recommendation is one of the main ways to solve the problem of Internet information overload[1], so many foreign experts and scholars have studied various recommendation algorithms. Collaboration Filtering is the most widely used personalized recommendation algorithm. Its core idea is to use the evaluation of a specific item by similar users of the target user to generate the evaluation prediction of this user[2-4]. The most significant advantage of a collaborative filtering algorithm is that it has no special requirements for recommended objects and can handle objects that are difficult to be expressed in structured text, such as movies and music[5]. However, the collaborative filtering algorithm has problems such as sparse score data and only considers the user's score data, but ignores many characteristics of the project and the user itself, such as the type of the movie, the release time, and the gender and age of the user[6]. How to make full and reasonable use of these features, such as the type of film, release time, user gender, age, etc. How to make full and reasonable use of these features to obtain better recommendation results is the main problem solved by the content-based recommendation algorithm. The content-based recommendation algorithm obtains the description of

the user's interest by analyzing the features of the items that the user has rated, and realizes the recommendation function by comparing the similarity between the description of the user's interest and the content information of the items[7-9]. However, content-based recommendation algorithms are inevitably constrained by the technology of information acquisition[5]. For example, it is difficult to automatically extract content features such as graphics and videos. Sarwar introduced SVD (Singular Value Decomposition) into a collaborative filtering algorithm[10], and used SVD to decompose the user's score of a project into a feature vector matrix of the user and the project, and then extracted some essential features by using the singular value of the score matrix based on the potential relationship between the user and the project. These characteristics are used to make recommendations. The proposed collaborative filtering algorithm based on SVD not only can not be restricted by information mining technology but also can solve the score sparsity in the collaborative filtering recommendation algorithm. However, with the advent of the Web 2.0 era, as an important feature of Web 2.0, social labels allow users to use open platforms to assign personalized labels to system resources and provide resource recommendations and sharing for users with the same interests[11]. The social labeling system mainly includes three elements: user, label and item, and all the above recommendation algorithms analyze the two-dimensional relationship between user and item, so the traditional recommendation algorithms cannot be directly applied to the social labeling system. To solve this problem, Symeonidis[12] first proposed to apply the tensor, which can fully represent high-dimensional data and maintain the eigenstructure information of high-dimensional spatial data, to the social label system and analyze and predict the label.

The main contributions of this paper are as follows:

1. Make recommendations based on user emotion and product emotion[13]

Traditional recommendation algorithms are mainly based on users' historical behaviors and interests, and seldom consider users' emotional factors. The recommendation algorithm based on emotion analysis can combine user emotion and product emotion to recommend, and more accurately meet the needs and preferences of users.

2. Consider the emotional evolution of the product

User emotions change over time and with usage, a product may be loved by users for a period of time, but over time, users' attitudes may change. The recommendation algorithm based on sentiment analysis can consider the emotional evolution process of products and update the recommendation results in time to ensure the accuracy and real-time performance of the recommendation results.

3. Consider your users' social emotions

Users' social connections also have a great impact on recommendation results, and users may be more willing to buy products used by their friends or idols. The recommendation algorithm based on sentiment analysis can consider the user's social emotions and combine the user's social network information to make recommendations.

4. Incorporate multiple sentiment analysis techniques

User sentiment analysis involves many fields, such as natural language processing, machine learning, deep learning, etc. Recommendation algorithms based on sentiment analysis can integrate a variety of sentiment analysis techniques to improve the accuracy and precision of recommendation algorithms.

2. Basic principles

The basic principle of a recommendation algorithm based on sentiment analysis is to analyze the sentiment or emotions expressed in user feedback or reviews and then use that information to generate personalized recommendations. This algorithm typically involves natural language processing techniques such as sentiment analysis, text classification, and clustering[14]. By analyzing the language used in reviews or feedback, the algorithm can determine the sentiment of the user towards a particular product or service. This sentiment information can then be used to recommend products or services that match the user's preferences or interests. Overall, the recommendation algorithm based on

sentiment analysis aims to provide more accurate personalized recommendations by considering users' emotional responses[15].

The recommendation algorithm based on sentiment analysis is mainly based on the following principles:

1. Emotion analysis: The algorithm analyzes and processes the user's emotional state by collecting the user's historical behavior data and emotional information, and turns the algorithm into an emotion vector to describe the user's emotional needs.

2. Item description: Emotion analysis is carried out on the description language of the item, and it is converted into an emotion vector for describing the emotional characteristics of the item.

3. Similarity calculation: The similarity calculation method (such as cosine similarity) is used to calculate the similarity between the user emotion vector and the item emotion vector.

4. Recommendation generation: According to the similarity calculation results, recommend items similar to the user's emotional state[16]. The basic flow of the recommendation algorithm based on sentiment analysis is shown as figure 1:
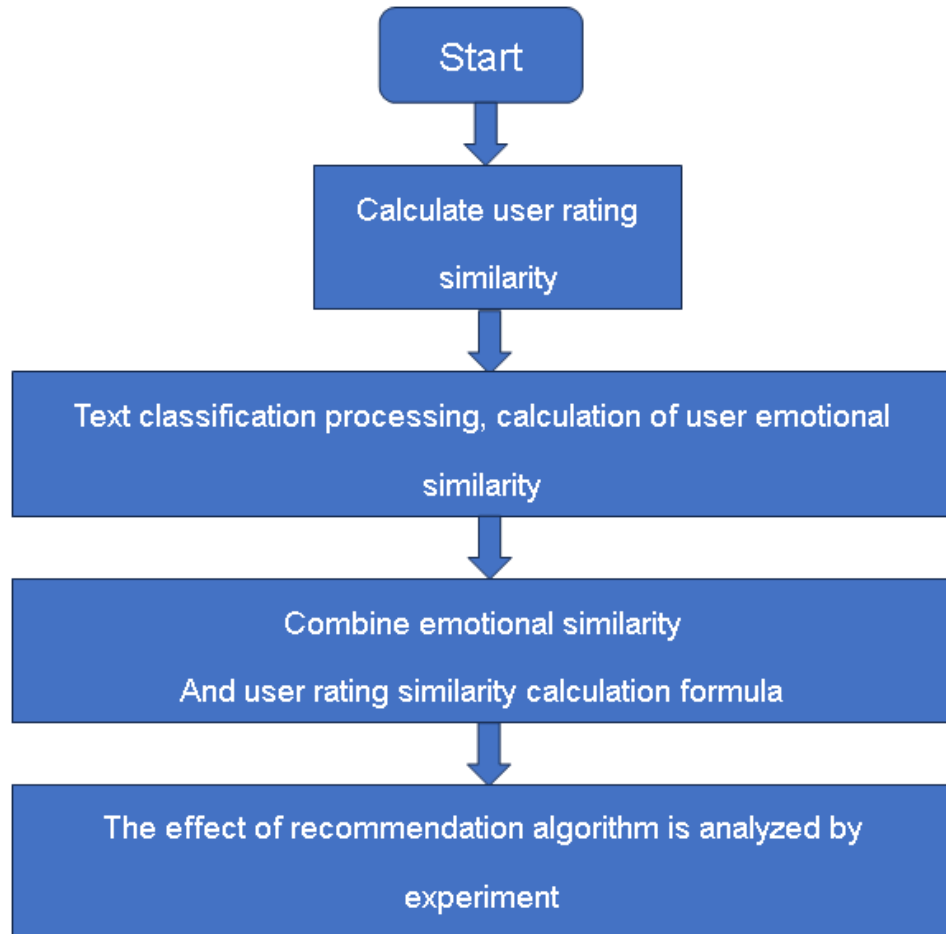

Figure 1. Flowchart of the recommendation algorithm based on sentiment analysis.

3. Application scenarios

The advantage of the recommendation algorithm based on sentiment analysis is that it can better understand users' emotional needs and improve the recommendation system's personalised recommendation effect.

However, the algorithm also has some challenges, such as the accuracy and reliability of sentiment analysis, and the difficulty of data collection and processing[17]. Therefore, it is necessary to consider

various factors comprehensively when applying the algorithm, and adjust and optimize it according to specific application scenarios.

The recommendation algorithm based on sentiment analysis is mainly applied to the following scenarios:

3.1. E-commerce recommendation

E-commerce platforms can use recommendation algorithms based on sentiment analysis to recommend products that meet users' emotions and needs based on information such as users' historical behaviors, social relationships, and emotional evaluations of products[18].

3.2. Social network recommendations

Social networks can use recommendation algorithms based on emotion analysis to analyze the emotional tendency of content posted by users and recommend friends, communities, topics, etc., that match their emotions.

3.3. Entertainment recommendations

Entertainment recommendations can use the recommendation algorithm based on emotion analysis to analyze users' emotions and preferences, and recommend entertainment products such as movies and music that meet users' emotions and interests.

3.4. Travel recommendations

Travel recommendations can use the algorithm based on emotion analysis to analyze users' emotions and preferences and recommend tourist routes and attractions that meet their emotions and travel needs.

3.5. Medical referral

Medical recommendation can use the recommendation algorithm based on emotion analysis to analyze the emotions and conditions of patients and recommend medical services and drugs that algin with their emotions and conditions.

In short, the recommendation algorithm based on sentiment analysis can be applied to various scenarios involving users' emotions and needs, so as to provide users with services and products that are more in line with their emotions and needs.

4. Machine learning and deep learning methods used in sentiment analysis-based recommendation algorithms

The article discusses a recommendation algorithm based on sentiment analysis. In this algorithm, both machine learning and deep learning methods are employed.

Machine learning methods are used to train models on sentiment analysis tasks. These methods include traditional machine learning algorithms such as Support Vector Machines (SVM), Naive Bayes, and Random Forests[19]. These algorithms are applied to sentiment analysis by using labeled data to train the models to classify text as positive, negative, or neutral. The models learn from the labeled data and are able to predict the sentiment of new, unseen text.

Deep learning methods are also utilized in the recommendation algorithm. Deep learning models, specifically Recurrent Neural Networks (RNN) and Convolutional Neural Networks (CNN), are trained on sentiment analysis tasks. RNN are particularly effective in capturing the sequential nature of text data, making them suitable for sentiment analysis[20]. CNN, on the other hand, excel in extracting local features from text, which can be helpful in sentiment analysis.

To train the deep learning models, labeled data is used to create a sentiment analysis dataset. This dataset consists of text samples and their corresponding sentiment labels. The models are then trained on this dataset using techniques such as backpropagation and gradient descent[21]. The models learn to

associate certain patterns in the text with specific sentiments, enabling them to predict the sentiment of new, unseen text.

In addition to sentiment analysis, the recommendation algorithm incorporates collaborative filtering techniques. Collaborative filtering is a method used to make recommendations based on the preferences and behaviors of similar users. This technique is combined with sentiment analysis to provide personalized recommendations that take into account both the sentiment of the text and the preferences of the user.

Overall, the recommendation algorithm discussed in the article combines machine learning and deep learning methods to perform sentiment analysis and make personalized recommendations. Machine learning algorithms such as SVM, Naive Bayes, and Random Forests are used for sentiment analysis, while deep learning models such as RNNs and CNNs are employed for more advanced sentiment analysis tasks. Collaborative filtering techniques are then incorporated to provide personalized recommendations based on the sentiment analysis results. This combination of techniques allows for more accurate and relevant recommendations based on the sentiment expressed in text.

5. Research progress

In the research of recommendation algorithms based on sentiment analysis, the main challenges are as follows:

1. Accuracy and reliability of sentiment analysis: The accuracy and reliability of sentiment analysis are important to the effect of recommendation algorithms based on sentiment analysis.

2. Difficulty in data collection and processing: The recommendation algorithm based on sentiment analysis needs to collect a large number of users' historical behavioral data and emotional information, and process and analyze these data at the same time.

3. Algorithm optimization and adjustment: Recommendation algorithms based on sentiment analysis need to be adjusted and optimized according to specific application scenarios to improve the recommendation effect.

In order to overcome the above challenges, researchers have proposed a variety of recommendation algorithms based on sentiment analysis, such as sentiment analysis algorithms based on deep learning and sentiment analysis algorithms based on network analysis. These algorithms have achieved good recommendation results in different application scenarios.

6. Future trend

The future of recommendation algorithms based on sentiment analysis is bright, with ongoing innovations and developments expected to provide users with better recommendations and overall user experience[22]. In this article, we will explore the trends and prospects of the future of recommendation algorithms based on sentiment analysis.

6.1. Integration of other data sources

In the future, the integration of other data sources, such as social media, browsing history, and purchase history, is expected to become more prominent. By combining different data sources, algorithms can generate more comprehensive and accurate recommendations, taking into account a user's preferences and interests across multiple domains[23]. For example, if someone has recently searched for and purchased hiking boots, a recommendation algorithm may suggest camping gear or outdoor equipment.

6.2. Use of deep learning models

Deep learning has had promising results in sentiment analysis, leading to more accurate and personalized recommendations. Deep learning models can analyze vast amounts of data, and learn patterns and relationships that may not be apparent to traditional machine learning models[24]. With the

advancements in deep learning techniques, more sophisticated algorithms will be developed that can better capture the nuances of user sentiment and preferences.

6.3. Adoption of explainable AI techniques

The use of explainable AI techniques is expected to become more prominent in the future. Explainable AI techniques provide users with more transparency and insights into how recommendations are generated, allowing users to better understand and trust the recommendations being provided. With the increasing concern about the transparency and accountability of AI systems, explainable AI techniques will become more crucial in gaining user trust and acceptance.

6.4. Ethical considerations

The protection of user privacy and the prevention of the misuse of sensitive data will continue to be an important trend in the future of recommendation algorithms based on sentiment analysis. As recommendation algorithms become more sophisticated and capable of generating personalized recommendations, there is a risk that user privacy may be compromised. Therefore, it is crucial for developers to ensure that user data is protected and used in an ethical and responsible manner.

6.5. Challenges

Despite the promising future of recommendation algorithm based on sentiment analysis, there are several challenges that need to be addressed. One of the challenges is the quality and availability of data. Recommendation algorithms rely heavily on data, and the quality of the data can significantly impact the accuracy of the recommendations[25]. Therefore, it is crucial to ensure that the data is of high quality and representative of the user base.

Another challenge is the issue of bias in recommendation algorithms. Recommendation algorithms can perpetuate and even amplify pre-existing biases in the data. Therefore, it is essential to ensure that recommendation algorithms are designed to avoid bias and promote fairness.

In conclusion, the future of recommendation algorithm based on sentiment analysis is promising, with ongoing innovations and developments expected to provide users with better recommendations and overall user experience. The integration of other data sources, the use of deep learning models, the adoption of explainable AI techniques, and ethical considerations will all contribute to more accurate and personalized recommendations. Further research and development in this field will continue to shape the future algorithms algorithms algorithms, and address the challenges and opportunities in this field.

7. Conclusion

The recommendation algorithm based on sentiment analysis is a hot topic in the field of recommendation system research, which can better understand the user's emotional needs and improve the personalized recommendation effect of the recommendation system. However, the algorithm also has some challenges, such as the accuracy and reliability of sentiment analysis, and the difficulty of data collection and processing[26]. Therefore, it is necessary to consider various factors comprehensively when applying the algorithm, and adjust and optimize it according to specific application scenarios.

At the same time, the recommendation algorithms based on sentiment analysis is an algorithm that uses natural language processing, data mining and other technologies to recommend goods, services or content that meet users' emotions and needs by combining users' emotions and products' emotions. It is mainly used in e-commerce, social networks, entertainment, tourism, medical and other fields.

In recent years, with the continuous development of emotion computing and machine learning technology, recommendation algorithms based on emotion analysis have achieved good results in accuracy, real-time, personalized and other aspects. At the same time, researchers also put forward many innovative points, such as combining user social emotion, considering the evolution process of product emotion, and integrating multiple emotion analysis techniques.

In general, recommendation algorithms based on sentiment analysis have great potential to improving user satisfaction, promoting product sales, and enhancing user stickiness[27]. With the continuous development and improvement of related technologies, recommendation algorithms based on sentiment analysis will be widely used and promoted in more application scenarios.

References

[1] Liu Jianguo,Zhou Tao,Guo Qiang,et a1.Overview of the evaluated algorithms for the personal recommendation systems[J].Complex Systems and Complexity Science,2009,6(3):1—10.

[2] Resnick P,Iaeovou N,Suchak M,et a1.GroupLens:An open architecture for collaborative filtering of netnewsVC]//ACM Conference on Computer Supported Cooperative Work.New York,USA:ACM,1994:175—186.

[3] Zhu Guowei,Zhou Li.Hybrid recommendation based on forgetting curve and domain nearest neighborr,J].Journal of Management Sciences in China,2012,15(5):55—64.

[4] Zhou Qiuyan,Zhang Yuan,Li Chen,et a1.Task recommendation method based on workers'interest and competency for crowdsourcing[J].Systems Engineering—Theory 8L Practice,2017,37(12):3270—3280.

[5] Liu Jianguo,Zhou Tao,Wang Binghong.Research progress of personalized recommendation system[J].Progress in Natural Science,2009,19(1):1—15.

[6] Deng Xiaoyi,Jin Chun,Han Qingping,et a1.Improved collaborative filtering model based on context clustering and user ranking[J].System Engineering Theory and Practice,2013,33(1i):2945—2953.

[7] Mooney R J,Bennett P N,Roy L.Book recommending using text categorization with extracted information[C]ff Proe Recommender Systems Papers from 1998 Workshop,Technical Report WS—98—08.Menlo Park,1998.

[8] Chang Y I,Shen J H,Chen T I.A data mining—based method for the incremental update of supporting personalized information filtering[J].Journal of Information Science&Engineering,2008,24(1):129—142.

[9] Zhou T,Ren J,Medo M,et a1.Bipartite network projection and personal recommendation[J].Physical Review E,2007, 76(4):046115.

[10] Sarwar B M,Karypis G,Konstan J A,et.a1.Application of cimensionality reduction in recommender system--a case study [c]//ACM Webkdd Workshop.New York,2000.

[11] Heymann P,Koutrika G,Garcia-Molina H.Can social bookmarking improve web search?[C]//Proceedings of the 2008 International Conference on Web Search and Data Mining.Palo Alto,California,USA:ACM,2008:195—206.

[12] Symeonidis P,Nanopoulos A,Manolopoulos Y. Tag recommendations based on tensor dimensionality reduction[C']}}Proceedings of the 2008 ACM conference on Recommender systems.Lausanne,Switzerland,ACM,2008:43—50.

[13] Zhang H, Li Y, Liu Y. A hybrid recommendation algorithm based on user sentiment and item popularity[J]. Mathematical Problems in Engineering, 2015, 2015: 1-8.

[14] Zheng W, Zhang B, Cai Y, et al. Emotion-aware music recommendation using deep neural networks[C]//2018 IEEE International Conference on Multimedia & Expo Workshops (ICMEW). IEEE, 2018: 1-6.

[15] Cheng Y, Wang Y, Liu Y, et al. Sentimental collaborative filtering: a baseline study[J]. IEEE Transactions on Knowledge and Data Engineering, 2018, 30(4): 754-767.

[16] Zhang Y, Li X, Li F. A hybrid collaborative filtering recommendation algorithm based on users' sentiment[J]. Journal of Computational Information Systems, 2013, 9(1): 1-6.

[17] Li Y, Yang Y, Liu L, et al. Deep collaborative filtering via marginalized denoising auto-encoder[C]//Proceedings of the 21th ACM SIGKDD International Conference on Knowledge Discovery and Data Mining. ACM, 2015: 811-820.

[18] Wang H, Lu J, Zeng H J. Improving personalized recommendation with sentiment analysis[C]//Proceedings of the 25th AAAI Conference on Artificial Intelligence. 2011: 1485-1490.

[19] Li X, Zhang Y, Li F. A sentiment-aware recommender system based on the collaborative filtering[J]. Proceedings of the 2012 International Conference on Information Technology and Software Engineering, 2012: 431-434.

[20] Chen, L., Li, P., & Zhang, Y. User sentiment-aware recommendation using deep learning models. In Proceedings of the 26th International Joint Conference on Artificial Intelligence (IJCAI), 2017: 3048-3054.

[21] Wang, H., Wang, N., & Yeung, D. Collaborative deep learning for recommender systems. In Proceedings of the 21st International Conference on Artificial Intelligence and Statistics (AISTATS), 2018: 448-456.

[22] Li, Y., & She, J. (2019). Deep collaborative filtering for sentiment-aware recommendation. Frontiers of Computer Science, 13(3), 566-579.

[23] Zheng, H., Wang, R., & Zhang, K. Affective recommendation with sentiment analysis and matrix tri-factorization. Information Processing & Management, 2018, 54(1), 1-13.

[24] Zhang, T., Liu, J., & Sun, M. Sentiment-aware recommender systems: A comprehensive survey. ACM Transactions on Intelligent Systems and Technology, 2019, 10(2), 1-32.

[25] Li, S., Zhu, X., & Wu, J. Affective recommendation using deep neural networks with hierarchical attention. Neurocomputing, 2018: 275, 320-329.

[26] Wang, R., & Zhang, K. Sentiment-enhanced collaborative filtering for recommendation. In Proceedings of the 10th ACM International Conference on Web Search and Data Mining (WSDM), 2017: 465-473.

[27] Liu, H., Wu, T., & Zhang, S. User sentiment-aware recommendation with deep fusion network. In Proceedings of the 33rd AAAI Conference on Artificial Intelligence (AAAI), 2019: 7860-7867.