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RSER: A Recommender System Based on Emotion Recognition Methods

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Abstract: With the growth of E-commerce, the development of recommender systems is helpful for users to select desirable products from all kinds of them. The existing e-commerce recommender approaches are based on a user's preference on music. However, sometimes, it might better meet users' requirement to recommend products according to emotions. In order to deal with them, a novel framework model for emotion-based e-commerce recommender systems is proposed. The core of the recommender system is the construction of the product vs customer emotion model by two-dimensional overlap spaces, which plays an important role in conveying emotions in products. Then the product feature extraction and propose some related matching algorithms for the construction of product vs customer emotion model is researched. The system model, data structures and so on are given in our paper. At last, experimental and analytical result shows the proposed emotion-based music recommendation achieves higher accuracy and faster retrieval speed.

Keywords: recommendation; emotion; overlay space; match

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INTRODUCTION

E-commerce has been growing rapidly, keeping pace with the Web. Its rapid growth has made both companies and customers face a new situation. Whereas companies find it harder to survive due to more and more competition, the opportunity for customers to choose among more and more products has increased the burden of information processing before they select which products meet their needs As a result, the need for new marketing strategies such as one-to-one marketing and customer relationship management (CRM) has been stressed both by researches as well as by practitioners. One solution to realize these strategies is a e-commerce recommendation that helps customers to search the products they would like to purchase by producing a list of recommended products for each given customer.

During the past decade, most research on recommender systems has focused on three areas[1-3]: (1) how to design algorithms that, given the past preferences of users, will make useful recommendations; (2) how to gather the information on user preferences as conveniently and unobtrusively as possible, and this issue runs the gamut from user interface research to marketing science; (3) privacy issues: how to combine the information gathered from a group of

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users to the advantage of an individual user, without divulging information about other users. And based on how recommendations are made, recommender systems are usually classified into the following three categories [4-7]:

Content-based recommendations: Recommendations are provided by automatically matching a customer's interests with items' contents. Items that are similar to ones the user preferred in the past are now recommended. Notice that recommendations are made without relying on information provided by other customers, but solely on items' contents and users' profiles. News-Weeder applied this method to build a net-news filtering system. Other applications include Tapestry, Info-Finder, Mooney, and so on.

Collaborative filtering: Recommendations are made for items that people with similar tastes and preferences liked in the past. This technique is widely used and is the preferred method for personal recommendation. Many systems, such as Amazon. com: Linden, Smith, and York, Sarwar: Sarwar, Karypis, Konstan, and Riedl, Hofmann, and they have adopted this technique.

Hybrid approaches: These approaches combine collaborative and content-based methods. Fab is a hybrid content-based, collaborative webpage recommender system that eliminates many handicaps of the pure versions of either approach. According to the classification scheme proposed by Adomavicius & Tuzhilin, hybrid recommender systems can be divided into four categories: (1) implementing collaborative and content-based methods separately and combining their predictions, (2) incorporating some content-based characteristics into a collaborative approach, (3) incorporating some collaborative characteristics into a content-based approach, and (4) constructing a general, unifying system that incorporates both collaborative and content-based characteristics.

But few kinds of olds are real-time, because they can not detect customers' real operation behavior including mouse, keys and so on. In this paper, we present a novel E-commerce recommendation system called RSER (Recommender system model based on Emotion Recognition). The rest of the paper is organized as follows. Section 2 makes a summary of traditional models and gives a distributed E-commerce recommendation model. In section 3, an emotion-based algorithm is given and its application is proposed. And in section 3, the message and data structures of RSER are given. Then its work flow is described in detail. Simulation results will be given in section 4. At last, section 5 concludes the paper.

1 SYSTEM MODEL

To sum up, old recommender system models have several described as following. (1) Some system models can not deal with real-time data by reason of historical data mining. (2) Shopping data can record customers' partial tendency and lost their spot data including feeling, sense and so on. In order to deal these problems, we propose a novel system model based on emotion discovery. As following, the main idea and its work flow are given.

Early, the most obvious commercial application of emotion sensitive systems is the game and entertainment industry with either interactive games that offer the sensation of naturalistic human-like interaction, or pets, dolls and so on that are sensitive to the owner's mood and can respond accordingly. Finally, owing to the shared basis of human emotion recognition and emotional expression, understanding and developing automatic systems for emotion recognition can assist in generating faces and/or voices endowed with convincingly human-like emotional qualities. This can in turn lead to a fully interactive system or agent that can perceive emotion and respond emotionally. This would thereby take human - machine interaction a step closer to human-human interaction. Another use of an emotion-sensitive system could be to embed it in an automatic tutoring application. An emotion sensitive automatic tutor can interactively adjust the content of the tutorial and the speed at which it is delivered based on whether the user finds it boring and dreary or exciting and thrilling or even unapproachable and daunting. But all these applications need special equipments to recognize customers' emotion, including mike, camera and so on. So e-commerce servers can't ask their customers to buy these. Then we proposed a novel emotion recognition method, which can classify emotion with usual I/O equipments such as keyboards and mousse. And our recommender system model can be figured with Fig. 1.

In the model, some traditional modules are utilized to implement recommender systems, such as Product OLTP and Data mine, Commerce Statistic and On-line DB. And

the customer emotion recognition and matching modules are the cores of the system model with related algorithms.

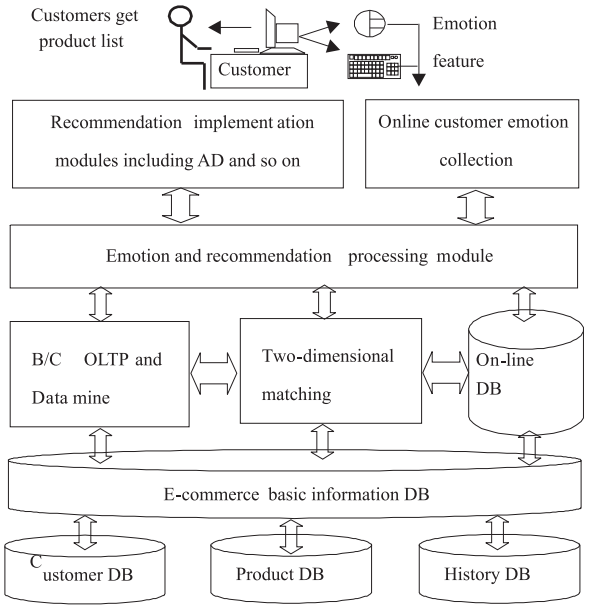

Figure 1. RSED system model

In the addition, the system work flow can be described as following.

(1) The first phase is a customer emotion-history profiling step, where product bought by a customer in the past is segmented into different clusters by recommendation processing modules. And related information is committed into these sub-DBs of E-commerce basic information DB, including transaction data and so on. And online customer emotion collection module is the core of the phase, which can monitor and recognize the emotion data of online customers. Further, the emotion data will be sent to the emotion and recommendation processing module.

(2) Some real-time information, including I/O operation frequency, customer retrieval and search items, can be classified and saved into the on-line DB, which provides transaction information and emotion features to the system.

(3) B/C OLTP and Data mine module integrates E-commerce basic information and real-time transaction information into recommendation items, including customer and related product information. At last, the module can find the relation between customers' historic record and product feature data, which can be provided to recommendation processing modules.

(4) Recommendation processing module, as our system core, integrates all kinds of data. And some related algorithms can be executed to recommend product items by it. Furthermore, the algorithms will search customer-product matching metrics. Then the module can provide recommendation lists, including customer items and interested product items. Also according to customer information, it can automatically choose specific methods to recommend. Through E-commerce push communication, related information can be transferred to the customers.

(5) Recommendation implementation modules (Push communication module), composed of Email, Note, and so on, can be bidirectional sub-module. Mainly, it can recommend product items to customers. Subsequently, the new product features are presented to it and the preference value that the customer possibly has for the new product can be predicted by the generalization inference ability of intelligent algorithms. And through other modules, the preference prediction values for all new products are ranked and the top-n items with the highest values will be recommended to the customers.

Note that our model can be extended for other recommender systems with little modification. And also, crazy agent colony algorithm can be utilized to replace other content-based recommendation algorithms in the system models. And the details of them can be described as following sections.

2 KEY TECHNOLOGIES

In the section, the main idea, model, data structures, and implementation models are given for related algorithms.

2.1 Main Idea and Model

Our system model can utilize three kinds of agents to deal with the recommendation problem. The first is a scout agent, which can be dispatched to collect the attracting trends of new recommendation products. The others are a band of carrier agents, which are sent to find recommendation products for customers. And the lasts are some salesman agents, which randomly recommend AD products to customer. And all kinds of agent models are described as following and showed in . figure 2.

With historic information about customer interests, scout agents can begin from B/C OLTP and Data mine module, and go to E-commerce Basic DB through transaction statistics module. In their journeys, they collect and classify

new customer interests. After enter into the E-commerce basic DB, they can use customer interest items as pheromone, which will be labeled on all kinds of products to recommend. Then, they come back the B/C OLTP and Data mine module with product attracting trends. At last, the agents find and label the relationship between products and customer trend. And primary pheromone has put on the products items for recommendation.

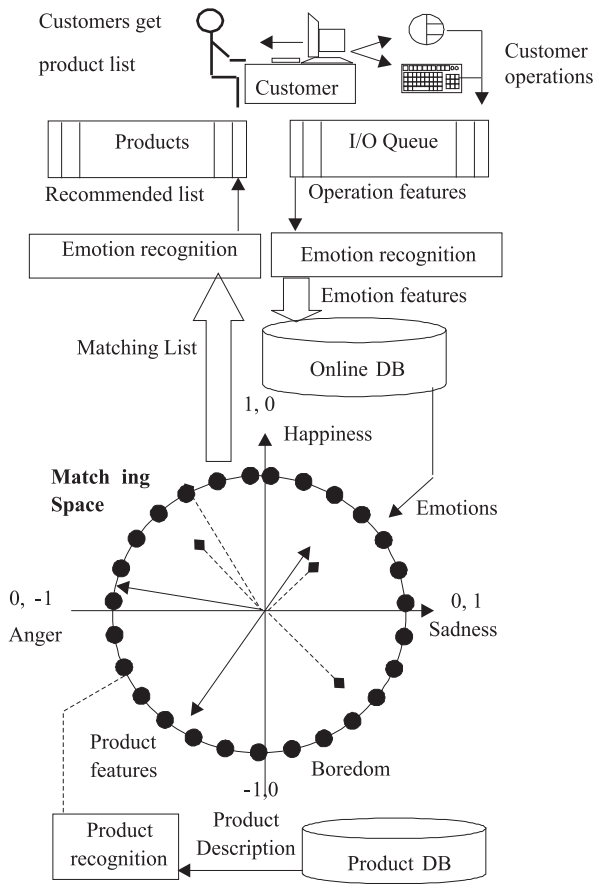

Figure 2. Emotion VS Product model

Carrier agents begin from the recommendation processing module (formicary), when some registered customers enter into the system. And each agent will serve for a registered customer. Also, they can collect and find the personalized customer's interests. As enjoyment information, all interests will be utilized to match the pheromone of product, when these agents enter into the E-commerce Basic DB. After collecting enough recommendation product information, the agent leaves back to their formicary and label pheromones on product items. When through the on-line DB, they will update the related information of equivalent customers. At last, they return to the formicary, and push recommendation product items to customers.

Salesman agents begin from the recommendation processing module (formicary), after some un-registered customers enter into the system and browse some product items. And each agent will serve for an un-registered customer, with their personalized information collected by salesman agents. Also, they can collect and find the un-registered customer's interests from customers' browsing sequences. As enjoyment information, all interests will be utilized to match the pheromone of product, when these agents enter into the E-commerce Basic DB. After collecting enough recommendation product information, the agent leaves back to their formicary and label pheromones on product items. When through the B/C OLTP and Data mine module, they will update the information of equivalent products. At last, they return to the formicary, and push recommendation product items to customers.

2.2 Emotion VS Products

In our works, emotion recognition is utilized in e-commerce servers and clients. Thus complicated I/O equipments such as photographs and physiological sensors can't be used by customers. And emotion recognition is implemented through detecting the frequencies and intensities of client I/O operations including boards and mouse. As some previous work, the emotions of RSER are featured by: a triggering event; a intensity proportional to the level of activation; an activation threshold; a list of hormones which are released when the emotion is active; and a list of physiological manifestations. The subset of discrete categories corresponding to 'primary' emotions is:

(1) Anger: a mechanism to block the influences from the environment by abruptly stopping the current situation.

(2) Boredom: A mechanism to stop inefficient behaviors that does not contribute to satisfy any of the creatures needs.

(3) Happiness. This mechanism on the one hand, it is a form of re-equilibration triggered by the achievement of a goal, and on the other hand, it is an attachment mechanism triggered by the presence of a customer's action.

(4) Sadness. Mechanism to stop an active relation with the environment when the creature is not in a condition to get a need satisfied.

According to the previous work, our emotion space can

be consisted of the above states. And the four basic emotions can be referred as respective positive/inverse directions: Sadness ≫X-axis positive direction; Anger ≫ X-axis inverse direction; Happiness ≫Y-axis positive direction; Boredom Anger ≫ X-axis inverse direction. Then a customer's emotion state can be described as a vector, whose length can be regarded as the emotion's intensity. In order to match each other and product features, all intensities are be standardized between 0 and 1. And all angles of emotion states are limited to 0 to 360.

In order to match emotion and products, our system model must superpose them into a two-dimensional feature space. And like emotions', product features be described as vectors. Then these vectors can be distributed into the two-dimensional feature space. Furthermore, a product's features may be distributed into several agents and matched respective emotion states. For an example, ice cream can be described as 'cold sweet tasty'. Thus it can calm down anger and please a customer. So its features will be distributed into two agents. When an angry or happy emotion state enters the space, ice cream will be matched with it. On the other hand, a novel product will be analyzed as a collection of respective feature, which can be matched with related emotions. And the two-dimensional feature space structure can be illustrated the figure 2.

3 SIMULATION RESULTS

The proposed system was compared with a traditional CF system and the random recommendation based on the same 200 item recommendation size. The traditional CF system includes the static customer profile establishing, customers clustering, and top-N items recommendation as shown in Fig. 3. The random recommendation on product categories and product items was performed 10 times, based on the same recommendation size used in the proposed system.

Figure 3 shows that RSER can provide personlized purchse options to customers. Thus the sale is more with RSER than with the CF system.

Figure 4 shows that RSER can make the system attract more consumers' attention than the CF system does. And in each simulation group, consumers spend more time in AD webs with RSER than without it. The performance of each system is evaluated in terms of recommendation precision, which measures the percentage that products recommended to a customer are actually liked by the customer. And the simulation results show the delays, when comsumer browse the recommended products. Futhermore, RSER can increase E-commerce turnovers. And the simulation results show the turnovers have been more about 10% than before. This can be explained by the unique properties exhibited by the RSER system such as user profile with multiple interests, adaptability to customer interest changes and the good robust learning and generalization inference ability exhibited by three kinds of agents.

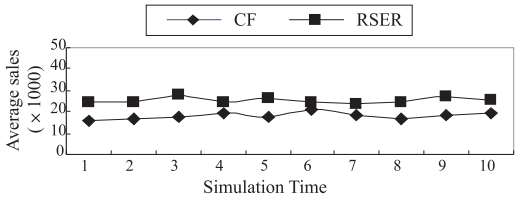

Figure 3. Simulation result1

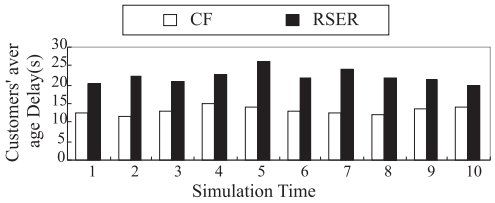

Figure 4. Simulation result2

4 CONCLUSION

In this paper, we propose a RSER recommender system system to help e-commerce websites provide better personalization service for their customers. The experimental results show that the our recommendation system is superior to the befores. In addition, the system should be applied to a real e-commerce environment where customers give their actual ratings to products for validating its practical effect.

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基于情感识别方法的推荐系统

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摘 要: 随着电子商务的高速发展,推荐系统已成为广大客户选择合意商品的重要工具。目前应用的电子商务推荐方法,依赖于客户的购物素养;而客户在购物中,更重要的影响因素是人的情感。针对这种情况,提出了一种新型的、基于客户情感的推荐系统;给出了该系统的模型、数据结构等。该系统的核心是商品和情感二维叠加空间。实验证明,该系统具有较高的推荐精度和检索速度。

关键词: 推荐;情感;叠加空间;匹配