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Survey of Intelligent Recommendation of Academic Information in University Libraries Based on Situational Perception Method

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Abstract

Based on the context-aware environment, in this paper, the adaptive interest models are reviewed. And the academic information intelligent recommendation systems of university libraries are presented based on the situational awareness-related theory method, where the current situation and trend of situational awareness-related theory and service of intelligent recommendation systems are investigated. Meanwhile, the potential research directions, basic ideas and methods are also presented. The adaptive model and architecture of the academic information recommendation system are built based on situational awareness, and the collaborative filtering information recommendation algorithm is studied based on spatial-temporal similarity relationship to obtain the interest of scientific and technological scholars. Combining with the adaptive interest model, an academic information demand model is established. On this basis, the prototype system of academic information recommendation is further studied to realize personalized recommendation of academic information based on the situational perception. This paper will provide effective solutions to the digital resources service of university libraries and the academic information recommendation needs of scientific and technological scholars.

Keywords: information recommendation system, situational awareness, context-aware environment, university libraries

1. Introduction

With the rapid development of Internet and mobile technologies, university library websites can provide more and more academic information for professors and students, who can review various academic information resources of libraries at anytime and anywhere. Meanwhile, it is becoming more and more difficult to find the interesting academic information quickly in the massive information of Internet.

In addition, professors' and students' demands for the academic information are also constantly changing according to the improvement of their knowledge and ability. For example, undergraduates may continue to study and become graduate students, and the associate professors may be promoted to be the tenured professors. If the information service provided by university libraries is ineffective, it would not be able to meet the requirements of professors and students for academic information, and the quality of information service could not be effectively guaranteed. Therefore, further research should be carried out to provide the effective information to professors and students due to the dynamic situational information.

In this paper, the situational awareness-related theory (SART) methods are investigated in the information service of university libraries, which is derived as the university libraries academic information intelligent recommendation system (IRS). In general, the IRS can automatically obtain and make use of the location, environment, scientists' and technicians' behavior and situation information. Then, according to the information, intelligent adaptive interest measuring model of scientists and technicians can be constructed, and the relevant similarity clustering algorithm and the collaborative filtering technology are presented to improve the recommended academic information based on the features of university libraries. In this way, the quality of academic information service of university libraries can be then improved.

2. Literature Review

This paper presents the academic information IRS of university libraries based on the SART method, in which the current situation and trend of SART and service of IRS are investigated. Schilit firstly proposed the concept

of situational awareness that means that software may make corresponding actions to the changes of the user's situation, which can be represented by the changes of location, server and peripheral devices. And, the situation can be divided into physical and human-related situations (Schilit & Theimer, 1994). Dey defined the situation as describing any entity, which can be the information about the object generated by the user and the system or the interaction between them (Dey, 2001). Niu et al. classified the user situation information into four aspects, that is, the user purpose information, the spatial-temporal information, the preference information, and the characteristic information (Niu & Li, 2011). Gu divided situational factors into user context, physical context, social context, time context and computing context (Gu, 2009). Other scholars also studied on situational information, most of which were based on the specific system application (Huang, 2015; Zhang, 2017; Rudra et al., 2018; Aupetit et al., 2017; Lee & Kang, 2016; Hess et al., 2019).

Service recommendation methods can effectively solve the issues of information overload and recommend items of interest to users. Currently, service recommendation methods mainly include the content-based recommendation method (Narducci et al., 2016), the collaborative filtering recommendation method (Lombardi & Vernero, 2017), the knowledge-based recommendation method (Qiao et al., 2014), the trust model-based recommendation method (Lu et al., 2018), the tag-based recommendation method (Bogers, 2018) and the combined recommendation method (Zhao et al., 2017; Wei et al., 2017). The comparison of the basic ideas, merits and shortages of each method are shown in Table 1.

Table 1. Comparison of recommendation methods

Recommendation methods	Basic principal	Merits	Shortages
Content-based (Narducci et al., 2016)	Obtain the user's interest from the selected object, compare it with the candidate object, and recommend the object with the most similar feature	Recommended features are most similar	Need to process multilingual information
Collaborative filtering (Lombardi & Vernero, 2017)	Users with similar behaviors have the same preferences, so it can recommend items of interest to users with similar behaviors	The most widely used and mature recommendation method	Cold starting and data sparsity
Knowledge-based (Qiao et al., 2014)	Recommend by inferring users' needs and preferences	High recommended accuracy	Need more features and user's preferences
Trust model-based (Lu et al., 2018)	A web-based service recommendation system	The recommended results have high reliability	Need more user's preferences
Tag-based (Bogers, 2018)	By analyzing the existing tags of users, recommend similar tags or resources to users actively	Can realize information sharing	Unable to recommend dynamic resources
Combined (Zhao et al., 2017, Wei et al., 2017)	Combined content-based, collaborative filtering and knowledge-based methods with each other or with artificial intelligence technologies	Can solve the problem of data sparsity	Complex structure

On the one hand, the needs of scientific and technological personnel are becoming more and more complex. How to accurately describe and fully explore the personalized and complex needs of scientific and technological personnel for academic information has become a difficult problem. Moreover, due to the huge number of digital resources in university libraries, how to effectively search and recommend many academic resources and fully explore the semantic connection between digital library resources has become a focus of attention. Traditional personalized services have been unable to meet the needs of users and the development of digital libraries.

3. The Potential Research Directions

Aiming at the current situation of digital library information service in universities libraries and the needs of scientific and technological scholar for personalized recommendation of academic information, the potential research can be done by using the internet of things and situational awareness technology to study the intelligent recommendation model of academic information in universities libraries based on situational awareness, so as to achieve efficient and accurate academic information push service. The potential research directions can be summarized as follows.

3.1 Acquisition and Expression of Situational Information of Scholars

The acquisition of situational information is the source of information recommendation, and the quality of acquired situational information also determines the quality of recommendation information. Information is mainly divided into explicit information and implicit information. The explicit information, including user rating

and labeling, is conducted by users according to their preferences. The establishment of interest explicit preference labels requires users to submit some personal interest keywords for the establishment of user preference documents, which requires the active participation of scientific and technological scholars and interferes with their behavior. Therefore, how to obtain the information of scientific and technological scholars invisibly has become the mainstream research direction.

The suggestion is to establish a database to store the real-time and historical information of scientific and technological scholars. The situational information is divided into explicit information and implicit information according to the acquired information (Taylor & Chi, 2006). It quantifies situational entities through weight calculation and calculates academic information of interest to scientific and technological scholars based on the weights adjustment of explicit information and implicit information.

3.2 Adaptive Interest Degree Modeling for Technicians Based on Situational Perception

The goal of establishing the interest model of scientific and technological scholars is to capture their interests from their situations and behaviors, to obtain their interest labels through the similar relationship between their interests and projects, and to provide personalized information services for them. The interest model of scholars is a model that describes users' interests, obtains and processes the information of users' interests, records and manages users' interests. In general, interest in the latest concepts will decline with time, and early access records have no significant impact on current interest, so the web pages of interest to the scholars should be similar as those visited recently.

Therefore, the suggestion is to consider the access time of scientific and technological scholars, to build an adaptive model with interest measure according to the combination of the interest in explicit and implicit interest, and to dig through the network and situational awareness information obtained by processing the interest preference weight. Under the condition of mining scientific and technological scholars in different preference attributes, explicit data are used to access to scholars' situation, the situation matching and the recommendation of academic real-time data information what the scholars are interested in. At the same time, this method can form the initial recommendation and solve the cold starting problem.

3.3 Collaborative Filtering Intelligent Recommendation Method Based on Adaptive Degree of Interest Model and Spatial-Temporal Association

The internet of things environment has spatial timeliness. As a part of the internet of things, situational perception environment also has space-time characteristics. Different scholars in the similar time and lending behavior tend to have similar sites similarity. In the process of building adaptive interest model, one can consider the scholars in the situational environment similarity relationship of time and space. The suggestion is to build the model and architecture of the academic information recommendation system based on situational awareness, and to study the collaborative filtering information recommendation algorithm based on spatial-temporal association. Combining the spatial-temporal association, the method combines the spatial-temporal association of itself with the spatial-temporal association of other users to obtain the interest of scientific and technological personnel. Combining with the adaptive interest degree model of scientific and technical scholars, an academic information demand forecasting model can be then established. On this basis, the prototype system of academic information recommendation based on situational perception can also be further studied to realize personalized recommendation of academic information.

4. Research Ideas and Methods

In this paper, the interests and preferences of scholars are suggested to be excavated by using situational awareness technology to capture the behavior of scholars. The adaptive interest model of scholars is established, and the situational information is matched with the interests of scholars. Thus, the academic information needed by scholars is recommended, and the users is adjusted adaptively to realize the personalized recommendation of academic information. The spatial-temporal similarity relationship and correlations and the scholars' interests are combined to design the adaptive interest model to excavate the interests of the scientific and technological scholars. Interested academic information is then recommended to the scientific and technological scholars.

The situational information management is mainly to obtain information, including explicit information and implicit information of scientific and technological scholars. Situational information acquisition is the organization and management of acquired data information and the adaptive interest modeling are based on orderly stored data information. The situational information processing is to match the real-time situational information with the adaptive interest model of scientific and technological scholars. Situational information recommendation refers to academic information related to the recommendation of scientific and technological

scholars by combining the spatial-temporal relationship and the interest relationship of similar scholars.

In order to obtain the interests and preferences of scholars comprehensively, the acquisition of situation information is also the key to obtain implicit information. Through the collection and processing of sensor data, the data are transformed into unified situational information data. Data mining technology can be used to obtain network information, to excavate the potential information of scholars. Physical devices such as sensors can also be used to obtain situational information, and the network can be used to mine the historical information of scholars. In addition, information mining technology is used to track and obtain implicit information, analyze the behavior of scholars and predict potential interest needs so as to provide academic information to meet their individual needs. The acquisition of situational information is shown in Figure 1.

Additionally, to adjust the spatial-temporal correlation between groups of scientific and technological scholars, there is a similar relationship in the scholars provided that space-time similarity exists. Then, similar interests can be recommended, and the spatial-temporal relationship can be combined to adjust the individual interest model. If the spatial-temporal correlation is large, then. the interest tag of scientific and technological scholars and recommend information can be obtained from the interest model. The recommendation process based on spatial-temporal relationship is shown in Figure 2.

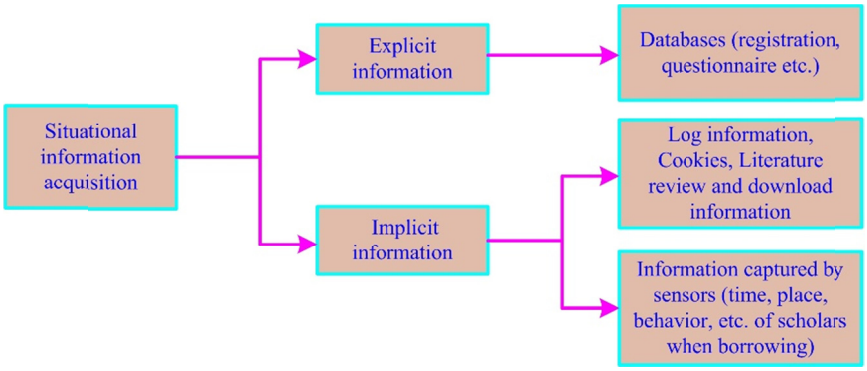

Figure 1. The acquisition of situational information

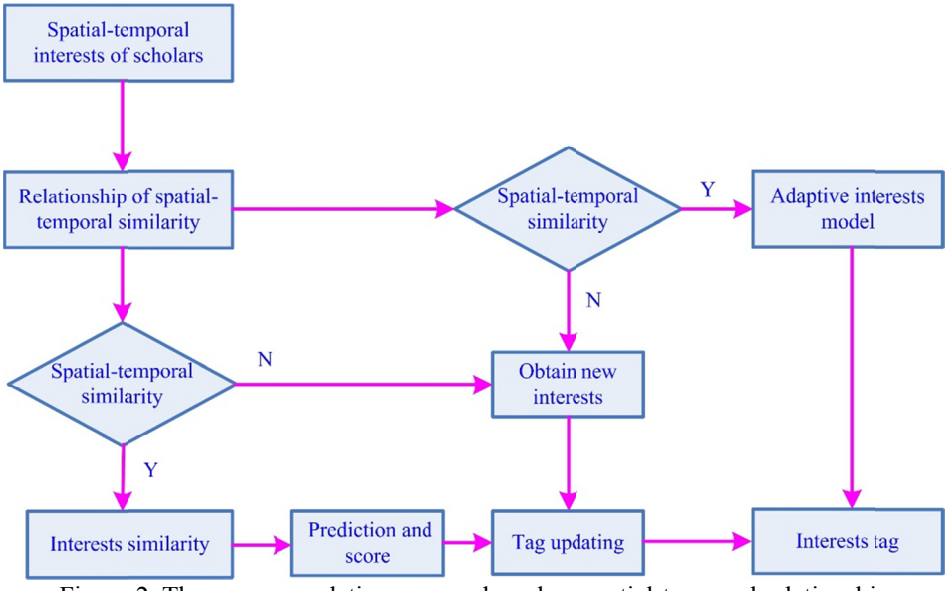

Figure 2. The recommendation process based on spatial-temporal relationship

Based on the context-aware environment, the adaptive interest model, which describes the spatial-temporal similarity relationship between the scientific and technological scholars, is designed to obtain the scholars' interests and concerns by the perspective of individual internal factors and the external interest factors of scholars who have the spatial-temporal correlation. And the internal and external factors are combined to

excavate the interests of the scientific and technological scholars. Interested academic information can be then recommended to the scientific and technological scholars.

5. Discussion and Conclusion

This paper starts with the analysis of the university's libraries information service, the research situations of recommendation requirements of academic information and recommendations. Then, the current university's libraries digitization construction is summarized in the process of academic information recommendation, and the corresponding solutions are put forward to solve these problems. Based on the context aware environment, this paper gives some suggestions for potential research directions, research ideas and methods. The adaptive interest model with scholars who have the spatial-temporal similarity relationship can be used to obtain the interests and concerns from the perspective of individual internal factors. The main research contents include:

(1) The situation information acquisition and expression of scientific and technological scholars in universities is quantified the situation entity by weight calculation and is calculated to obtain the academic information that scientific and technological scholars are interested according to the adjustment of explicit and implicit information weights.

(2) The adaptive interest model of scientific and technological scholars is designed based on situation perception. The feedback of scholars is obtained through situational awareness, and the model is then constantly adjusted and optimized.

(3) Based on adaptive interest model and spatial-temporal association, the collaborative filtering intelligent recommendation method is combined with the adaptive interest model of scientific and technological scholars, which is constantly updated to establish a prediction model of academic information. The prototype system of academic information recommendation can be then realized based on the situational awareness.

The implementation of this method will provide effective solutions to the digital resources service of university Libraries and academic information recommendation requirements of scientific and technological scholars. However, there are still some main difficulties need to be solved.

(1) How to effectively obtain the interest information of scientific and technological scholars, and then build a situational adaptive interest degree model.

(2) How to consider the correlation between explicit and implicit interests of users in the context, so as to realize the effective combination and comprehensive processing of dynamic situational interest.

(3) Collaborative filtering of academic information recommendation algorithm based on adaptive degree of interest model and spatial-temporal association are also difficulties.

In this paper, the adaptive model and architecture of the academic information recommendation system are built based on context-aware environment and situational awareness, and the collaborative filtering information recommendation algorithm is presented based on the spatial-temporal similarity relationship to obtain the interest of scholars. In this way, the academic information recommendation system can be built to obtain the personalized academic recommendation information. As a future work, the systematic review and meta-analysis of intelligent recommendation methods will be further conducted.

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