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Extended Access Control and Recommendation Methods for Enterprise Knowledge Management System

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Abstract

Knowledge Management (KM) is one of the hotspots for research in the past decade. In most cases, the number of users in a Knowledge Management System (KMS) is very large, and they are from varied departments, even other companies. In this paper, some defects when existing methods about access control and recommendation are deployed in KMS are analyzed to show that these widely-used approaches need to be extended. To overcome the deficiencies of previous work, this paper proposes an extended Role-Based Access Control (RBAC) method and a hybrid recommendation approach for Knowledge Management System. Also, a real-life system is presented to verify the proposed methodology.

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Keywords: Knowledge Management; Access Control; Hybrid Recommendation; Collaborative Filtering

1. Introduction

With the fast change and high pace of modern life, today's corporations are facing fierce market competition. To deal with the fast-changing need of the market and the complex business environment, people came to realize the value of knowledge. Corporations tend to pay more and more attention on the subject of

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knowledge, thus shifting the business strategy from products-based to knowledge-based. Quintas et al. [1] stated Knowledge Management (KM) is a process of managing knowledge, which aim to manage existing and acquired knowledge assents to meet needs for now and develop opportunities in the future. After that, KM and Knowledge Management System (KMS) has been a focus in both academic and industrial fields.

When developing a Knowledge Management System recently, we find there are still some interesting topics about KMS which need to cover. To begin with, access control gives authority to access to certain restricted areas or resources. Compare with most IT systems, KMS tends to address on information sharing rather than authority limitation. As a result, traditional access control method such as Role-Based Access Control (RBAC) is probably not suitable for the situation of the access control for KMS. In addition, when recommendation method is used, KMS may provide more information to the algorithm compared with e-commerce or social network service. In order to expose users more potentially useful information, a hybrid recommendation method in knowledge recommendation based on collaborative filtering is proposed.

The rest of the paper is organized as follows. A brief review of study on access control and recommendation as well will be given in Section 2. Then their deficiencies are analyzed. Section 3 presents an introduction of the structure of the New Generation Knowledge Management System we are current developing. In section 4, the extended RBAC accessed control method is established. Section 5 proposes the hybrid knowledge recommendation method. Section 6 presents the conclusion and future work.

2. Related researches

RBAC has been very successful in both research and applications. Ferraiolo et al. [2] were the first to propose the model of RBAC, and the idea is users are connected with roles, and that it's roles rather than users that are connected with privileges. Sandhu et al. [3] proposed the model of RBAC96, which includes 4 different models, i.e., core RBAC (also known as RBAC0), hierarchical RBAC (RBAC1), constraint RBAC (RBAC2), and symmetric RBAC (RBAC3).

After that, lots of research works have been proposed to extend RBAC model. Luning Xia et al. [4] proposed the N-RBAC model to simplify the complexity of the role hierarchy structure by the use of a namespace. Lilin Ma et al. [5] established a structural model with the thought of layered management, which consists of 3 different aspects, i.e. access permission card, functional operation control and data access control. Qi Li et al. [6] proposed a novel RBAC model for decentralized and distributed systems, which can be applied to group-based applications with dynamic assignments.

Despite its simplicity and effectiveness, traditional RBAC may be not suitable for a knowledge management system. The access control of IT system should make a balance between authority limitation and information sharing. In most application situations, users tend to be strictly limited to certain authorities. In Knowledge Management System, however, in order to encourage knowledge utilization and innovation, the sharing of information should come first. In addition, tradition RBAC only defines a relatively simple relationship among different users with the concept of role. However, this may not be enough for current situation in KMS, where there may be dynamic virtual organizations as well as traditional departments.

Recommendation system has been widely investigated and adopted in the past decades. The approaches which recommendation systems use include data mining approaches, content based methods and collaborative filtering, etc. Among these approaches, collaborative filtering is the most popular one for the past few years and is widely used in various fields such as e-commerce, film community, music community and social networks due to its simplicity and high prediction accuracy. It can be divided into memory-based and model-based. [7] With this approach, the system can infer users' interests with pervious data (grades in most cases) and use this information to help users to find suitable information or item. The two general classes of collaborative filtering approaches which are commonly used are user-based methods and item-based methods.

To get better result when selecting neighbors for the active user, Liang Zhang et al. [8] proposed a novel method by using the variance of the process of computing similarity.

If the method of collaborative filtering is applied to the system directly, however, there may be some defects. Different from other systems such as e-commerce and film community, in KMS, lots of information about users can be known even when they just register; also, there are not as many users and items as other systems, which makes it incompetent to make recommendation by using collaborative filtering.

3. New generation knowledge management system

Companies and organizations create knowledge all the time during the whole process of operation. Not just knowledge items are important. As people retain critical business knowledge, they are also among the most valuable assets in a company. Fig. 1 is the structure of the KMS we are working on.

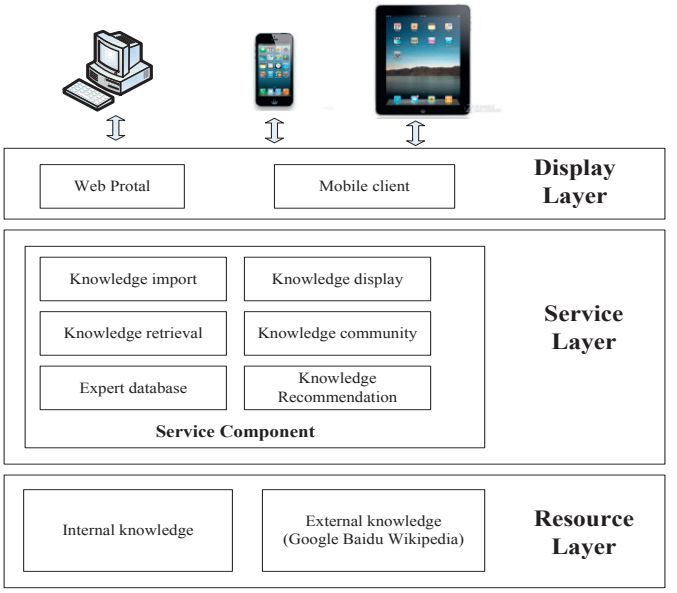

Fig. 1. Structure of new generation knowledge management system

The first layer is the display layer, which makes it possible for users to visit the system via browser or mobile phone. Since the portal plays a significant part in the process of interaction, it's necessary to provide convenience and usability.

The second layer is service layer, which consists of varied service components to provide varied functions. With knowledge import, not only local files in all the formats but also knowledge items on the Internet, e.g. Wikipedia, can be uploaded to the system and tags can be attached to knowledge items. Knowledge display gives users a clear view of the knowledge items, which are organized by category. In addition, the function of on-line preview is available for knowledge items in the format of doc, ppt, xls and so on. Knowledge retrieval is a search engine, which provide common search and advanced search. Knowledge forum is a place where qualified users can make comment and give a mark for a certain item. Expert database help to manage expert information, a valuable asset. Experts can modify their profile while other users can find the professional field (area of expertise) of a certain expert. Knowledge Recommendation is of great value to encourage innovation.

The third layer is the resource layer, or the knowledge base. It is responsible for storage and is the basis of the first two layers. As is indicated in the figure, there are two sources, including files from inside the company and information from the Web such as Wikipedia and Google.

4. Extended RBAC access control method

In KMS, users should be encouraged to get more knowledge for the purpose of innovation. For this purpose, a 2-tpye user group structure is introduced for an extended RBAC model, whose core idea is that users can be added to two different kinds of group and privileges are given to groups as well as roles.

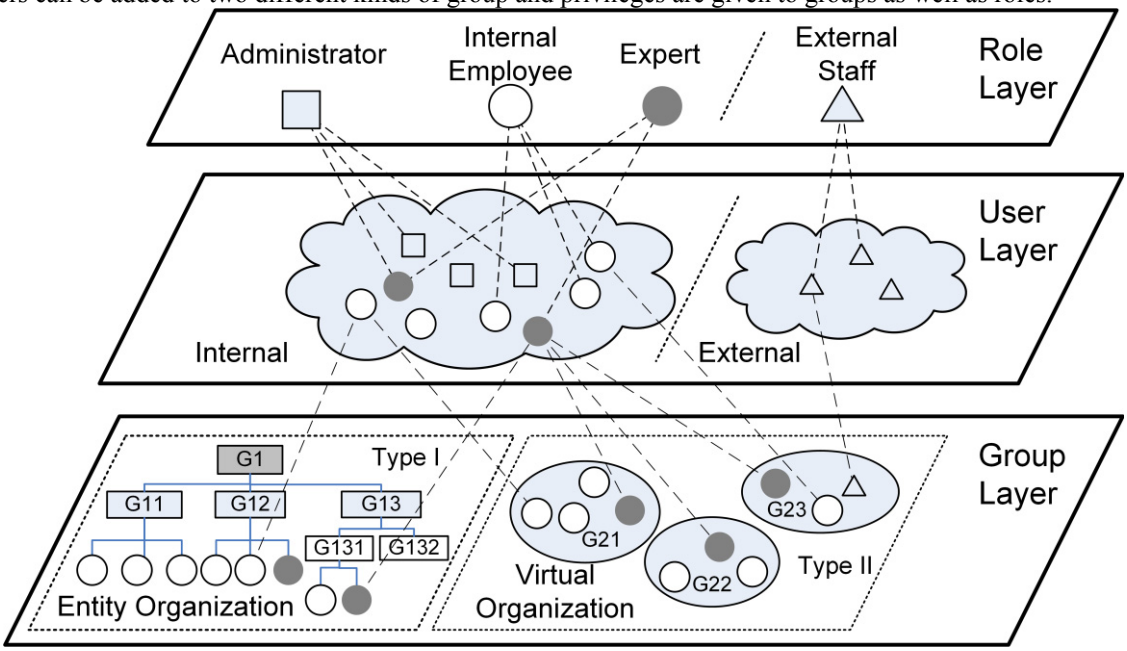

Fig. 2. Relationship of user, roles and groups

Fig.2 briefly shows the relationship of user, roles and groups. The limitation to users can be divided into two kinds, one about system function and the other about data, or knowledge items to be more specific. A typical example of the former kind is the function of expert database. If the user is an experts, he can modify his profile. If not, however, then he only has the authority to scan the information of experts. An example of the later kind is the limitation to certain knowledge items. When it comes to classified knowledge item, it's required that only authorized users can have access to it. These two requirements should be treated separately.

To meet these two demands, three layers are introduced, the user layer, the role layer and the group layer. The role is for the limitation about functions while the group is for the limitation about data. In this way, the access control model proposed above provides access control for not only functions but also data.

As is the same with traditional RBAC, it's roles rather than users that are connected with privileges. Each user is related to one or more roles, one role is related to one or more permissions about functions. In other words, role acts like a connection between user and permission. Table 1 indicates the relationship in the KMS.

Table 1. Connections between roles and functions

Role	Knowledge import	Knowledge display	Knowledge retrieval	Knowledge community	User management	Tag management	Expert database
Administrator	√	√	√	√	√	√	√
Expert	√	√	√	√	×	√	√
Internal Employee	√	√	√	√	×	×	√
External Staff	×	√	√	×	×	×	×

As for the concept of group, it's somehow similar to role. It's also a connection between user and permission, but in another aspect. While role goes with the limitation about function, it goes with limitation about data. As is universally acknowledged, there is organization structure in each company, formal ones and informal ones included. Formal one means different departments and committees, while informal ones, which are sometimes called virtual organization, are dynamic team within the boundary of the company.

In most case, when a user logs in the KMS, he only has access to common knowledge or the knowledge items within the boundary of the organization he is in, his own department and some virtual organizations. For instance, a senior manager in production department can have access to common knowledge such as company rules, department knowledge like production plan, and knowledge from a consultant team he is in.

In corresponding to these two kinds of organizations, the group layer is divided into 2 types. Permanent groups indicate the pyramid-like structure while dynamic groups indicate virtual organizations. Each user is related to one or more groups, one group is related to one or more permission, and the groups can be created or deleted according to needs.

5. Hybrid recommendation method

With the problem of information overload, it's harder and harder to find the suitable information. In consequence, recommendation system based on user's personal information or history data has been widely used in many web-based activities such as e-commerce and online news system. A typical example for that is collaborative filtering.

The situation is more or less the same with KMS. Proper knowledge is of great importance in the process of knowledge utilization and creation. In many cases, staff are facing too much information and knowledge in companies. At the same time, there are also some new problems in KMS, which makes tradition collaborative filtering not very suitable. First, companied to tradition application environment, cold start effect is not obvious. In KMS, as soon as a user registers, lots of personal information about his position and education background can be known. As for knowledge items, tags can be used. In addition, considering practical application environment, there may be experts and other information systems in the company. To solve these problems, a hybrid recommendation system for KMS is presented based on collaborative filtering.

- Extended Collaborative Filtering Recommendation

To start with, there are other ways to set up links between uses and knowledge items besides traditional marks. Similarities between users can also be judged based on their positions, which are closely linked with the access control model proposed above. In terms of knowledge items, as has been mentioned previously, tags can be attached. Since this, tags can be used to judge similarities between each item. With a better understanding of users, the system can make more accurate recommendation with these methods.

- Cross-system Recommendation

In addition, there may be other information systems in the company. Based on the history data of them, personalize recommendation can be made without a previous knowledge of the field. In business environment, business process management system (BPMS) often acts as the core of these systems. As a result, special attention should be paid on it. Associations between tasks and knowledge items can be set in advance. With the data of history operation and tasks to do, proper knowledge can be found.

For example, Jim is an experienced quality-control manager with the supervision of product A but has little experience with product B. Based on the log of the BPMS, Jim has completed the supervision task of product

A 26 times, and product B only twice. Now in the to-do list of Jim, there is a supervision task of A and B. So the KMS should recommend some knowledge about product B to help Jim with the supervision.

- Experts Recommendation

Finally, as experts' opinion is of great use, qualified experts can make recommendation to target position.

Table 2 is an introduction of all the recommendation algorithms adopted. U presents the set of all users while I presents set of all items. Besides, u stands for the target user. As a whole, these algorithms form a hybrid recommendation system to ensure users get what they need.

Table 2. Comparison of recommendation algorithms adopted

Recommendation approach	Collaborative Filtering	Cross-system Recommendation	Experts Recommendation
Input	Scores and comments U made for I	History data for u in other systems	Experts' opinion
Strengths	Not need knowledge of certain field Recommend automatically	Recommendation can be personalized	Simple, effective
Weaknesses	Cold start problem	Need data from other systems Need associate data with items	May largely depend on experience of experts

6. Conclusion

In this paper, an extended RBAC method and a hybrid recommendation approach are proposed to overcome the deficiencies when traditional RBAC and collaborative filtering are deployed in KMS. As most companies have many departments and even virtual organizations, the concept of groups is introduced. By making connections between user and role as well as user and group, the extended model retains the main features of RBAC and makes it easier to administrate access control when the model is deployed in a large enterprise system. Enterprise knowledge management system tends to have less users and items than other web-based applications, which can provide enough data for traditional collaborative filtering. The hybrid recommendation approach proposed above use data from various sources to get a better result of recommendation. It significantly improves simplicity of the recommendation system in KMS.

Further research work includes: (1) to set proper weight for the three approach in the hybrid recommendation approach; (2) to formalize the extend RBAC access control model and verify its consistency.

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