University Campus Social Network System for Knowledge Sharing

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Abstract. Public online social network services have achieved dazzling success in recent years. As a result, vertical social network services for universities are expected warmly by campus users. As the majority of activities in university campus are knowledge and social interaction intensive, one of the core functions of campus social network system is to facilitate knowledge sharing on campus. In the cyberspace of universities, knowledge is stored in various kinds of digital resources such as documents, photos, videos etc. In this paper, we discuss the design and implementation of our campus social network system, concentrating on knowledge sharing mechanism in the system. The knowledge sharing mechanism has five features including the utilization of users' personal social network to facilitate the dissemination of digital resources, the use of a six-tuple model based tagging to realize the unified labeling for digital resources, the fine-grained access control based on friend lists for safer knowledge sharing, the adoption of a multi-scale evaluation method for digital resources and personalized recommendation for digital resource with social graph based collaborative filtering as its core idea. With all these considerations, we expect to improve the efficiency and effectiveness of knowledge while enlarging the dissemination scope of digital resources carrying it in cyberspace of universities.

Keywords: Vertical Social Network Services, Knowledge Sharing, Digital Resource, Social Tagging.

1.   Introduction

Online social network services are considered one of the most popular network services in recent years, with billions of users spending huge amount of time every day on social network sites including Facebook, Twitter, Flickr, YouTube, Linkedin in U.S. and Sina Weibo, RenRen, QZone in China etc. [4, 16, 20, 25, 28, 36, 38]. People use online social network services to share information and knowledge with their friends in real life, build online connections with new friends on network, follow celebrities and other network friends to get more and fresher news, and release their own information to

their followers or the public. These behaviors can help users to strengthen their weak ties effectively with only low cost [14], and weak ties are generally thought to be beneficial for creativity [29]. As the tremendous success that social network services have gained during the past few years, it's also regarded as the third revolutionary application of the Internet after search engine and Web2.0 applications.

Campus users of universities including students, faculty members and staff members are among the most active users of Internet services, especially emerging services including social networking services. As we all know, Facebook and RenRen, which are the biggest social network systems in the world and in China respectively, are both originated from prestigious American and Chinese universities. Although public social network services like Facebook, Twitter, Sina Weibo and RenRen provide good individual and group communication services to their users, they are isolated from universities' cyberspace of campus users. For this reason, public social network services have two disadvantages. On one hand, because it cannot be connected with the real environment and activities of universities' campus, it cannot support the learning, teaching, research and cultural activities on universities' campus closely and timely; on the other hand, public social network systems cannot provide strict information and privacy protection to their users and organizations that users are belonged to because of their consideration on commercial interest.

As it's known to us all, the fundamental responsibilities and core competitiveness of universities are the creation, dissemination and utilization of knowledge of all disciplines; and the majority of activities in universities are learning, teaching and research. While learning and teaching can be regarded as activities for knowledge sharing and collaborative knowledge building [19], research can be regarded as activities of knowledge creation. In a word, all these activities are knowledge and social interaction intensive. Research has shown that social network and social interaction within it are important to both knowledge creation and knowledge sharing. On one hand, social interaction positively influences the quality of the knowledge created [7]; on other hand, social network can help students to share experiences and collaborate on relevant topics [21].

Based on the above considerations, it's both necessary and useful to build campus social network system in the cyberspace of universities. The core function of campus social network system is to facilitate and encourage knowledge sharing and knowledge creation on campus. Specifically, the core functions of campus social network system are to support online communication, sharing and collaboration in learning, teaching and research activities of campus users. Knowledge sharing and knowledge creation are closely related with and continuously influenced by each other. Because campus social network system provides direct support to knowledge sharing and indirect support to knowledge creation, we put our emphasis on knowledge sharing in the following part of this paper.

In the following sections, we begin by the discussion on the definition and classification of social network system. Then we make detailed analysis of

the changes that campus social network system will bring to the knowledge sharing in the cyberspace of universities' through the comparison of digital resources dissemination without and with campus social network system. After that, we examine the design and implementation of our campus social network system which consists of fundamental components, core components, application services and open platform interfaces. Finally, we discuss the five features that are expected to stimulate and facilitate knowledge sharing in campus social network system.

2. Related Works

Social network system for organizations is a special category of social network system which accepts users within a single organization or multiple organizations. Different from public social network system which may use nickname or real name, social network system for organizations use real names and to provide higher level of trust [26]. Furthermore, social network system for organizations is more business-focused, the core responsibility of it is to help members of the organizations to achieve higher efficiency and better performance. Therefore, social network systems for different type of organizations may differ in content and styles of discussion [23, 30]. Generally speaking, large-scale organizations tend to set up independent social network systems which are usually customized to the organization's special requirement and integrated with other enterprise applications, small and medium-sized organizations tend to use shared social network systems which are similar in design and independent of other enterprise applications.

Enterprise social network system and campus social network system are two typical type of social network system for organizations. Because enterprises and universities have different mission, functions and business; enterprise social network system and campus social network system have different design concerns. For enterprise social network system, its content may be more work-related and cannot be open to non-employee of its belonging enterprise. For campus social network system its content may be more diverse and a considerable part of its content can be open to users who are outside of the belonging university. Furthermore, the access time of enterprise social network system may be more intensive in working hours, while the access time of campus social network system may be more scattered.

Many world-class companies have built up their own enterprise social network systems. Beehive is the enterprise social network system for IBM employees since 2006 [8, 9]. IBM Connections is the commercial software suite of new generation enterprise social network platform; it serves more than 400,000 employee of IBM in 175 countries and many employees in IBM's enterprise customers at present [26]. InnovationCafe is the enterprise social network system for NEC which mainly provides blog based social network services to employees. It's reported that InnovationCafe has

changed employees working styles and accelerated their communications beyond the barriers of different departments and organizations [12]. Yammer is one of the most popular corporate Twitter clones which is restricted to employees of the enterprise and served as online services [37]. It provides basic services for free and charges for additional services.

There are also many campus social network systems for universities. PhoenixConnect is an academic social network for the University of Phoenix in U.S. [18]. It serves more than 1,100,000 students, faculty member, and alumni of the university. Ewhaian is a social network system for Ewha Womans University in South Korea. It was launched since 2001 and has about 50% users who will log into the site on a daily basis. It's quiet successfully in terms of steadily increasing active users and engaging participation of current students [35]. Hotseat is a social networking tool in Purdue University that aims to connect students to each other and their instructors in these large lecture conditions. It also creates a backchannel of collaborative discussion both in and out of the classroom [1].

The university campus social network system we proposed in this paper is similar to the enterprise social network systems and campus social network systems we mentioned above in terms of the common features of social network systems. It's different from them in terms of target users, user relationships, digital resource sharing models, and focus. Firstly, it targets students, teachers, and staff members of our university. Secondly, because almost all students and many teachers and staff members live in the same campus, there are much more abundant relationships between them. Thirdly, we provide fine-grained access control for digital resources which allows users to share digital resources with more careful access control. By this way, we are expected to be able to decrease the possible conflicts in different social spheres of users. Finally, we put our focus on facilitating and encouraging knowledge sharing and knowledge creation on campus. We provide campus users with a simple and useful method to label digital resources, adopts multi-scale evaluation for digital resource and personalized recommendation for digital resources, and helps users to find more useful digital resources through personalized recommendation for digital resources.

3. Definition and Classification of Social Network Systems

Social network systems, also called social network sites or social network services, are defined as web-based services that allow users to construct a public or semi-public profile within a bounded system, articulate a list of other users whom they share a connection, and view and traverse their list of connections and those made by others within the system [6]. From the definition, we can conclude that the three core elements of social network systems are (1) user profile, (2) user relationship, and (3) the visibility of user profile, user relationship, user created information, user behavior etc. under

the privacy rules of the system and the privacy setting of users. User created information may include tweets, blogs, photos, videos etc. that users released and their value-add information such as comments, collections, recommendations etc. in social network system. User behavior is manifested by dynamic messages describing it in social network systems. The visibility of users profile, user relationship, user-created information, and user behavior can help to accelerate the socialization of individuals and enhance the interactions between them.

There are different ways to classify social network systems. According to the focus of social network systems, they can be classified as organic social network systems and hybrid social network systems. Organic social network systems are people-focused and embed social network features within. Hybrid social network systems are content-focused; they combine traditional Internet services and social network by integrating social features. For example, Twitter is an organic social network system and Flickr is a hybrid social network system [31]. According to users' features and purposes of using social network systems, we can classify social network systems as public social network systems and vertical social network systems. Public social network systems usually accept all Internet users as system's user, and allow them to do things like sharing, commenting, forwarding, keeping and recommending on tweets, photos, blogs etc. Most of the well-known social network systems including Facebook, Twitter, Weibo and RenRen are public social network systems. Vertical social network systems usually accept users with some common features or within the same organization. Enterprise social network system, campus social network system and other social network system for organizations all belong to vertical social network. Except for the functions that public social network systems provide, vertical social network systems also add some specific features for their special purposes. Because we have listed many examples of enterprise social network system and campus social network system in the previous section, next we will only introduce several examples of vertical social network system which accept users with some common features. For example, LinkedIn is a vertical social network system for professionals [28], Sermo is a vertical social network system for licensed physicians, INmobile is a vertical social network system the wireless industry [34], Instant Knowledge is an enterprise based social network that aims to introduce employees of the enterprise to contacts within the organization who may have skills relevant to particular tasks [33].

## 4.   Knowledge Sharing in Campus Social Network System

As we have mentioned above, learning, teaching and research are the three basic categories of activities of universities' students, faculty members and staff members. One of the most important features of these activities is knowledge and social interaction intensive. Learning and teaching are mainly organized by means of courses, which can be regarded as activities for

knowledge dissemination and collaborative knowledge building; research is mainly organized by means of research projects, which can be regarded as activities of knowledge creation. In the cyberspace of universities, knowledge is stored in various kinds of digital resources such as documents, photos, videos etc. In order to illustrate the changes that campus social network system will bring to the knowledge sharing in the cyberspace of universities', we are going to make detailed analysis of the dissemination of digital resources without and with campus social network system using the dissemination of courseware as our example scenario.

4.1. Digital Resources Dissemination without Campus Social Network System

Digital resources dissemination without campus social network system is usually done through email or web sites for courses and projects. When digital resources are disseminated through email, only course members or project members who are in the mailing list of specific courses or projects can get related digital resources. When digital resources are disseminated through web sites, although everyone who has access to the web sites can get the digital resources theoretically, only few people except for course members or project members will know the existence of these web sites. In the latter case, as there is no notification for the changes of digital resources, users should check also the web sites from time to time to get the up-to-date digital resources. This is both time consuming and boring. As a result, the dissemination scope of most knowledge will usually be in very limited scope. Furthermore, because courses and most projects have a relatively short lifecycle, such as one semester or one year, the effectiveness of knowledge will be influenced by its limited time of existence.
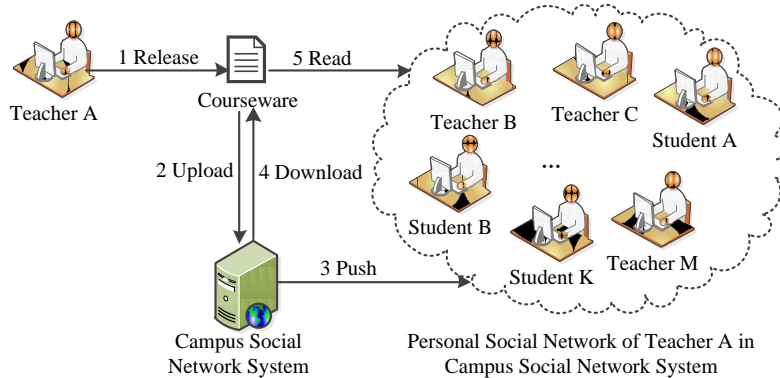
Figure 1 depicts the scenario of courseware dissemination through learning management system and email. In learning management system, the courseware created by teacher A can only be accessed by the students in his/her classes. Students can download the courseware from the course space in learning management system after the teacher release it. Besides, if his/her colleges know about his/her course and want to get its courseware, they may ask him/her for the courseware, and the teacher can send it as attachments of the email. After the end of the course, course members will seldom access the courseware, leaving it in a state of existence with rare attention. In other words, the lifecycle of courseware is usually the same as the course. The courseware in the mailbox of his/her colleges will always be in similar status in most cases. Maybe the receiver will delete it or let it stay in his mailbox and forget its existence after short scan. In both situations, the courseware will be disseminated in a limited scope and likely to be useless in the long term.
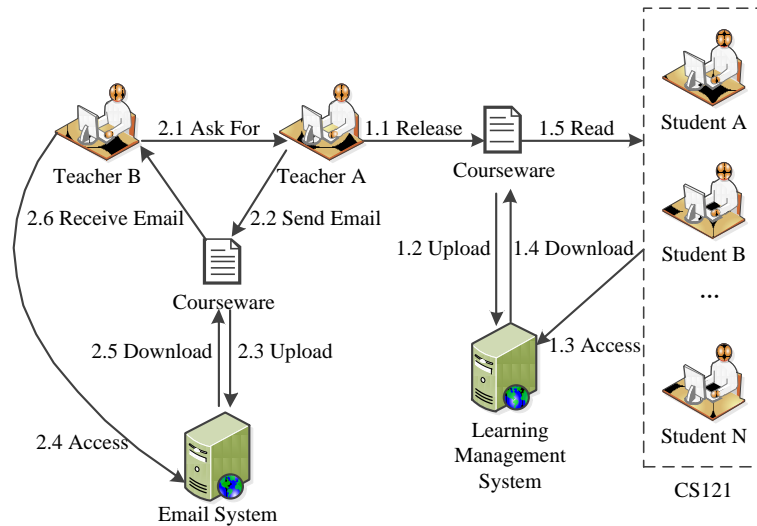
Fig. 1. Digital Resource Dissemination without Campus Social Network System

4.2. Digital Resources Dissemination with Campus Social Network System

Every user in campus social network system has many contacts. These contacts may be his/her friends in Facebook and RenRen, mutual followed user in Twitter and Weibo, or group members in all of the above. Collections of the contacts form the personal social network of a user. With campus social network system, dissemination of digital resources is greatly different. Firstly, the dissemination of knowledge will be in a larger scope and much more timely. All users in the personal social network of the user who released the digital resources will receive them immediately. This can not only reduce the cost of getting digital resources and save time for receivers, but also achieve better user experience. Secondly, the effectiveness of knowledge will be enhanced because the digital resources carrying knowledge can exist actively for much longer time than the lifecycle of a course or a project.

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Fig. 2. Digital Resource Dissemination with Campus Social Network System

Figure 2 depicts the scenario of courseware dissemination with campus social network system. After teacher A release a courseware in campus social network system, every user in his/her personal social network will receive a short message from the system immediately saying that he/she has just released a courseware by a special mechanism named news feed which will reduce users' cost of accessing information from their contacts greatly [17, 32]. If someone is interested in the courseware, he/she can download it to his/her computer or just read it online. After that, he/she may write some comments on the courseware and forward it to the users in his/her own personal social network. This process can be repeated many times within only a few minutes, making the courseware be read by hundreds and thousands of users.

The dissemination scope of digital resources in campus social network system is decided by several factors including the influence of the user, the number and influence of his/her contacts, the usefulness of the digital resources, and even the time of release etc. By this way, digital resources may exist actively for longer time than they are in learning management system or users' mailbox which will make it possible to be much more useful.

5. Design of Campus Social Network System

Campus social network system is a typical vertical social network system. Firstly, it only provides services to campus users of one or more universities. Secondly, its key value is to facilitate knowledge sharing on campus and its core functions are to support the daily communication and campus activities including learning, teaching and research of campus users. Thirdly, it's an important and indispensable part of universities' cyberspace which has close connection with other parts of it. Finally, it adopts a well-designed information and privacy protection mechanism for campus users and universities.
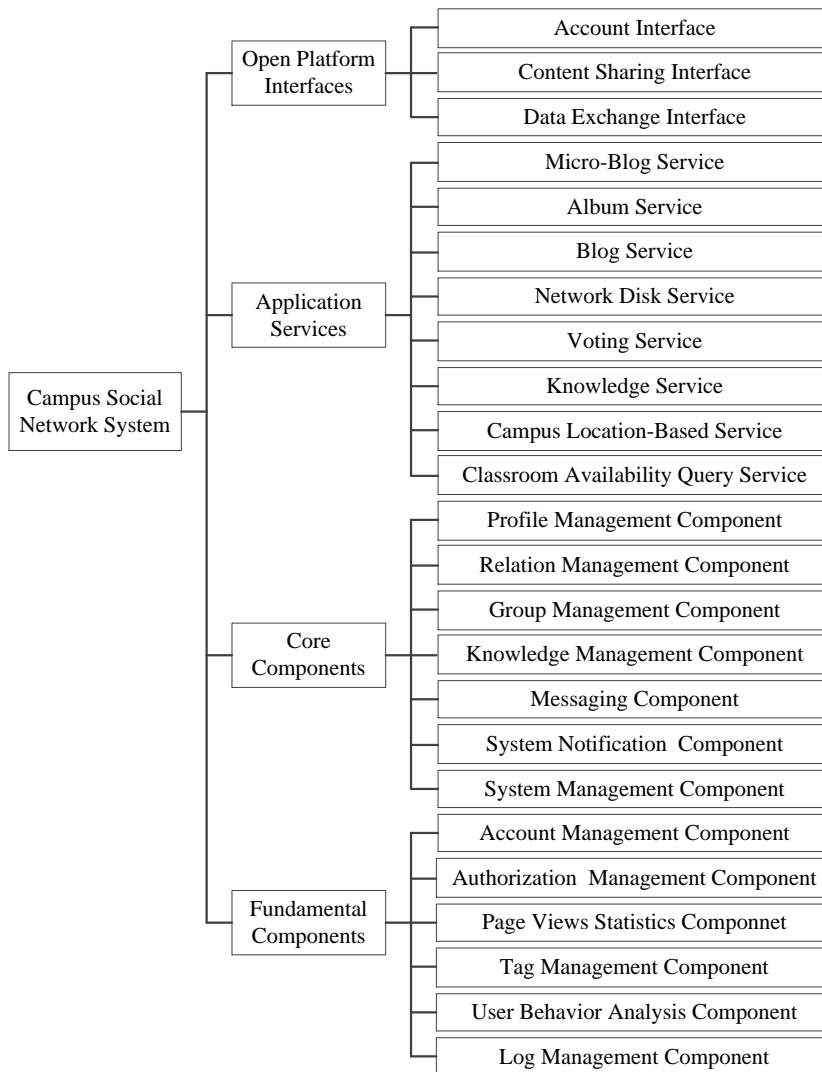
Fig. 3. Architecture of Campus Social Network System

Campus social network system consists of four parts: fundamental components, core components, application services and open platform services, as shown in figure 3.

5.1.   Fundamental Components

Fundamental components are common components of information systems which are similar to campus social network system. These components not

only deal with the system's accounts, authorization, tags and logs; but also keep tracking of users' page views and fulfill basic user behavior analysis in system.

5.2. Core Components

Core components contain the three components that manage core elements of social network system: user profiles, user relationship and groups; the key component of campus social network system: knowledge management; and other three components which are closely related to them: messaging component, system notification management and system management component.

5.3. Application Services

Because users usually spend most of their time on application services when they are active in campus social network system, they are the key to achieve good user experience of the system. In campus social network system, application services can be divided into two categories. The first category of application services contain common services including micro-blog service, album service, blog service, network disk service and voting service that most of the current social network systems have. The second category of application services contains specialized services including knowledge management service, campus location-based service and classroom availability query service that are designed specifically for campus users.

5.4. Open Platform Interfaces

There are two purposes to implement open platform interfaces for campus social network system. The first purpose is to connect campus social network system with other parts of universities' cyberspace. As we mentioned above, campus social network system is an important part of universities' cyberspace. Therefore, it must exchange information and coordinate with other parts of universities' cyberspace. The second purpose is to allow people who are outside of R&D team of campus social network system to develop application services independently and freely. These interfaces are designed to address the problems of account sharing, content sharing and data exchange.

6.   Knowledge Sharing Mechanism in Campus Social Network System

Knowledge sharing in computer systems is not a new research topic in computer science field. The main purpose of knowledge sharing is to improve knowledge reusability to make them more valuable. A lot of research and engineering efforts have been spent on the design and implementation of knowledge-based systems using ontologies [15]. By this way, knowledge can be understood and used by computer systems. With the popular of web services, the application of ontologies is extended to the research of semantic web [24].

We use a social network based method to facilitate the sharing of knowledge in campus social network system. The knowledge sharing mechanism in campus social network system has the following five key points. Firstly, personal social network of users provide the basic channel for knowledge sharing in campus social network system. Secondly, unified labeling for digital resources not only provides users with a simple and useful method to label digital resources, but also makes it possible to build another channel for knowledge sharing. Thirdly, fine-grained access control for digital resources allows users to share the digital resources with more careful access control. Fourthly, multi-scale evaluation for digital resource and personalized recommendation for digital resources make users can find more useful and high quality digital resources with less effort. Finally, personalized recommendation for digital resources is expected to help users to find more useful digital resources.

6.1.   Personal Social Network of Users

The personal social networks of users are the most special and valuable data of campus social network system. The collection of these personal social networks can be described using a huge graph that contains countless informal social networks. These informal social networks are recognized as important and unique relationships among scientific and technical personnel [3]. As a result, we regard personal social networks of users as the basic channel for knowledge sharing. With network relationships and news feed, digital resources released by campus users can not only be able to be disseminated rapidly or even explosively in a short time, but also be able to be disseminated in a wider scope than it will do in tradition ways.

6.2.   Unified Labeling for Digital Resources

Tagging is a simple and useful method to label digital resources. People use tags to describe digital resources for sharing and future use with minor efforts using keywords [22]. When used in social applications like social network

system, tagging is known as social tagging. We take unified tagging strategy for digital resources in campus social network systems. Different from the traditional triple model, we use a six-tuple to describe each tag:

Tagging（Object, Tag, Tagger, Source, Type, Time）

In the six-tuple, "Object" is the digital resource to be tagged; "Tag" is the keyword used to describe to the digital resource; "Tagger" is the user who tagged the digital resource; "Source" is the domain that the digital resource belongs to; "Type" refers to the type of digital resource, such as document, photo, music, video, web address, user, group, activity etc.; and "Time" is the time of tagging [11].

When a considerable part of digital resources in social network system have been tagged by large amounts of users, we can build another channel for knowledge sharing through campus users' collaborative tagging for digital resources [10]. The channel provides a new chance for users to discover and access digital resources according to their content features.

6.3. Fine-Grained Access Control for Digital Resources

In most social network systems, access control of contents and digital resources is coarse-grained. Specifically, when a user wants to publish a message such as a micro-blog, he will usually be allowed to choose whether to publish it publicly or publish it to all of his friends. Some social network systems also allow users to publish it privately. People need to maintain independent social spheres in real life. That is to say, they usually play different role, build connections and communicate with different people, and join different groups in their daily life. As a result, the technological features of news feed based on the entire friend list in most current social network services may make their social spheres in conflict and bring online tension to them [5].

In order to achieve better and more natural user experience, we adopt a fine-grained access control design for digital resources in our campus social network system. The fine-grained access control is based on friend categories of users. With this design, users can choose to publish digital resources to specified categories of friends. Furthermore, digital resources for specified categories of friends cannot be shared again by users who received it. By this way, we make online knowledge sharing more safely and comfortably, and this are expected to stimulate users' behavior of knowledge sharing in campus social network system.

6.4. Multi-Scale Evaluation for Digital Resources

We adopt a multi-scale evaluation method for digital resources in campus social network system. This method combines objective evaluation criteria with subjective evaluation criteria to get comprehensive evaluation

information for digital resources. The objective evaluation criteria include number of visits, comments and collections, reflecting the popularity of digital resources; the subjective evaluation criteria include 10-point scale score and number of sharing, reflecting the quality of the digital resources.

Objective evaluation information and subject evaluation information for digital resources from campus users form collective knowledge of the digital resources which will be helpful to users in making their decision [27]. For example, when a user wants to find lecture notes about data mining, he/she can just browse lecture notes that have the highest score or the maximum clicks. In a word, multi-scale evaluation for digital resource helps users to find high quality digital resources with just minor effort.

6.5. Personalized Recommendation for Digital Resources

Personalized recommendation is an important feature for most e-commerce web sites such as Amazon, TaoBao etc. and many other web based services including Google, YouTube, Flicker etc. The objects of recommendation may be books and any other commodities in e-commerce web sites; or virtual objects such as web sites, videos, photos, and blogs etc. in many web based services. Collaborative filtering is recognized as one of the most useful and widely used recommendation algorithms [13, 2].

To help users to find more useful digital resources, we incorporate a personalized recommendation module for digital resources in our campus social network system. The module uses collaborative filtering as the core idea of recommendation. Moreover, it takes advantage of the social graph in the system. Instead of generalize and rank recommendation result totally based on the history of users' behavior, we add the strength of users' relationship into consideration. The digital resources accessed by closest friends with the most similar interest will get the highest ranking.

7. Summary

As a typical vertical social network system for campus users of universities, campus social network system is a newcomer to the cyberspace of universities. We implemented a campus social network system for our university. The system consists of four parts: fundamental components, core components, application services and open platform interfaces. Firstly, like most social networking systems, campus social network system maintains personal social networks of campus users which can be described using a huge social graph that contains countless informal social networks. Utilizing the informal social networks by news feed in campus social network system will enlarge the dissemination scope of digital resources where knowledge is stored in. Secondly, through the use of unified labeling and the adoption of multi-scale evaluation method for digital resources, users can evaluate the

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digital resources and add new value to them. The collection of tags and evaluations of all users will not only produce the collaborative tagging, classification, and ranking etc. of digital resources; but also provide a new chance for users to discover and access digital resources according to their content features and quality. Furthermore, fine-grained access control for digital resources using friend lists are expect to achieve better and more natural user experience, which will stimulate users' behavior of knowledge sharing. Finally, personalized recommendation using collaborative filtering as its core idea can help users to find more useful digital resources. Our future work concerns empirical study of user behaviors for knowledge sharing, improvement to the performance of the system and design of more suitable evaluation method for digital resources.

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