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Abstract—With the rapid development of technology and fast iteration of knowledge, a good way to manage knowledge can greatly help people improve their work efficiency. But up to now, existing systems for knowledge management still can be improved in many aspects. In this research, we focus on the aspect of sharing and organizing knowledge. Most existing systems do not pay much attention on how to easily share all the information to everybody using this system, and do not give efficient ways to organize the information into good shapes. This paper gives an implementation of a system for sharing and organizing knowledge that absorbs advantages from other systems.

Keywords—knowledge management, knowledge sharing, knowledge organizing

I. INTRODUCTION

A. Background

Knowledge Management is a subject of academic and business applications that began to rise globally in the mid 1990's. It does active and effective management in identifying, creating, mastering, using, sharing, and spreading explicit knowledge and tacit knowledge owned by individuals and communities.

The level of knowledge can be divided into 4 stages: data, information, knowledge and intelligence. Knowledge formation can be divided into 3 steps. First step is collecting some data. Second step is finding useful information from the data. Third step is using this information coupled with personal ideas and practices, to finally generate knowledge. When applying knowledge and personal experience to everyday life, it becomes intelligence. For example, when we produce a report, we will collect a large amount of data at first, find out the information that can be used in the report from the pile of data, and then finish the report using this information with our own ideas and practices. When we finish the report, what we learn from the report will turn into our own knowledge [1].

Peter Drucker, the father of modern management, once said: "The productivity of scientific researchers is the biggest challenge for management in the 21st century." The use of knowledge management tools can undoubtedly help scientific researchers grasp clues from massive information, clarify the structure from complex relationships, dig out regular patterns through rapid changes, and finally give a multiplier effect on the management of knowledge [2].

Personal knowledge management tools have a certain amount of technical development and user accumulation. Each type of tool has common and individual characteristics and has its own application scenario. The concept of personal knowledge management has also been introduced into the services of scientific institutions, universities and libraries and many other information providing and managing agencies and shows its great development prospects.

Good knowledge management tools also play an important role in enterprises. They can fully mobilize employees of various departments to contribute their own enterprise knowledge, manage complex knowledge content and formats, and build enterprise knowledge bases. They can help employees easily access knowledge, make full use of knowledge, improve work efficiency and reduce duplication of effort.

B. Motivation

Nowadays, people spend a lot of time on the Internet. They see news by Internet, grasp information by Internet, learn new things by Internet, and communicate with others by Internet. People can access to a vast amount of information on the Internet and it is a good habit to collect some of the valuable information for personal use. When the collection has a lot of stuff in it, it is hard to find out the things needed quickly.

After learning some new knowledge, how to organize it and share it to others is always a big problem. Teaching and learning consume a lot of time and energy.

Existing systems those can be applied for knowledge management lack a convenient way to share what authors recorded in them and most of them do not provide enough functions to organize the large amount of information.

A good system for sharing and organizing knowledge will perfectly solve these problems. People won't cost much time on finding the information they want from a list of links and texts, won't consume a lot of energy on converting knowledge in their mind into sentences every time and teach it one by one.

C. Overview

Sharing and organizing knowledge are always important to knowledge management [3].

This paper designs a new system for knowledge sharing and organizing. Evaluation and discussion is made after the implementation.

The new system includes the following features: intuitive knowledge structure displaying, simplified operations of knowledge organizing, providing several methods for sharing, learning and referring organized knowledge.

II. RELATED WORK

Many experts and scholars have done a lot of research on knowledge management in the past 20 years. And there are also many companies and organizations that have developed software and tools that can be used for knowledge management.

Here is a brief introduction to some of the well-known systems that could be used as knowledge management tools.

1) Wikipedia

"Wikipedia is a multilingual, web-based, free encyclopedia that is based on a model of openly editable content. It is the largest and most popular general reference work on the Internet and is named as one of the most popular websites [4]."

Features are free content, free editing. There are many contributors, all editing operations are completed online, and the submission of the edits can be viewed by all people on the web page. Therefore, it has the advantages of easy sharing, fast update, and rich content. It is good for the users who want to learn new concepts because each concept is a single entry in Wikipedia.

But Wikipedia also has some unavoidable shortcomings at the same time. Such as the cumbersome editing and indexing of similar concepts. And Wikipedia is not good for learning knowledge that has many concepts. Because editors concentrate more on how to explain concepts better instead of how to organize knowledge into good shapes.

2) Microsoft OneNote

"Microsoft OneNote is a computer program for free-form information gathering and multi-user collaboration. It gathers users' notes (handwritten or typed), drawings, screen clippings and audio commentaries. Notes can be shared with other OneNote users over the Internet or a network. OneNote is available as a part of Microsoft Office and Windows 10. It is also available as a free standalone application for Windows, macOS, Windows RT, Windows Phone, iOS and Android [5]."

As a container and information repository collected from different sources, OneNote is ideally suited for organizing a large amount of information from a course or research project. Its advantage lies in the fact that it is very convenient to record information. Simply copying and pasting can directly record information such as text, pictures, videos and web pages in notebooks. At the same time it also pays great attention to the synchronization function, you can login accounts on multiple devices for notebook synchronization.

The disadvantage is that although each note is stored in a tree structure, it is cumbersome and not intuitive to expand the tree while viewing. When the number of notes gets large, the desired information can be basically found only by searching and checking recent notes. So it may be good for storing information but not good for organizing knowledge.

3) Blog

Blog is a website or online diary that is managed by individuals, posts new articles, pictures, or videos to record, express emotion, or share information [6]. Articles on blogs are usually arranged in reverse order from new to old, depending on the posting time. Many bachelors now use it for knowledge management, that is, sharing their understanding of a certain area of knowledge on blogs for preservation and communication.

If the creator's thinking is clear, reading a blog is a very good way of acquiring knowledge, because the articles are categorized and written according to its wishes by authors who are relatively more knowledgeable in this field. Sometimes the author's own learning process and operation process are recorded, which reduces the possibility of readers taking many detours.

The disadvantage of blog is that editing takes relatively more time, and it is not easy to categorize articles and increase their relevance.

4) Evernote

Evernote is a mobile app designed for note taking, organizing, tasks lists, and archiving.

The app allows users to create notes, which can be a piece of formatted text, a Web page or Web page excerpt, a photograph, a voice memo, or a handwritten "ink" note. Notes can also have file attachments. Notes can be sorted into a notebook, tagged, annotated, edited, given comments, searched, and exported.

Evernote is cross-platform, including support for iOS, Android, Microsoft Windows and macOS.

Various editing methods and multi-platform are the biggest advantages of Evernote. But when there are too many notes, the visibility of the structure is relatively poor.

III. SYSTEM DESIGN

A. System requirement (Overview)

In this paper, we design and develop a new system for knowledge sharing and organizing. In the system, we need to attain following things:

- Allow users to manage and share their knowledge easily.

- Allow users to view knowledge base created by others.

- Allow users to search the key words through concept and content.

- Store and present knowledge structures in an intuitive way.

- Allow users to collect and refer knowledge created by others.

For making our description not too abstract, we have some assumptions on the knowledge:

- People classify knowledge by domain. Usually we can classifying concepts into different domains, and different people are proficient in different areas of knowledge.

- Most knowledge in the same domain can be covered by a range of concepts. Different concepts reveal different aspects of knowledge, enough concepts can give a comprehensive description to the knowledge in a certain field.

- This series of concepts are represented by tree-structure. Almost all the data is managed in tree-

structure, an article, a book, the computer file system, and so on. It proves that people feel comfortable using tree-structure to organize a series of information.

- A concept consists of the sum of some content and some other concepts. If the concept is an atomization concept, then we can just describe them by a definition and some description. If not, it usually consists of other concepts.

Based on those assumptions, some concepts are defined as follows:

1)   Brain

The concept "brain" is a tree-structured topic map in the new system, users take notes or record their knowledge in different fields by creating different brains into their accounts.

Users can edit and view their brains at any time. And by setting the status of the brains into public, users can share their brains (knowledge) to others. With the sharing function, people can easily exchange their ideas, teach others and learn something new from others' brains.

2)   Concept

"Concepts are mental representations, abstract objects or abilities that make up the fundamental building blocks of thoughts and beliefs. They play an important role in all aspects of cognition [8]."

In the new system, each "concept" is a node in a tree-structured topic map. A "brain" is combined with many related "concepts". Each brain has a root concept that contains other concepts in the brain. Each concepts may have its parent concept, which means the concept belongs to the parent concept, and children concepts, which means the concept can be divided into different parts (each part is a child concept).

By adding "concepts" to the "brains" and enriching these "concepts", users can easily organize their knowledge in this new system.

Considering that the concepts users are going to add to their brains may have already been well described in other brains, so users can refer (copy) concepts from other brains to avoid duplication of effort.

Usually users can only see a few concepts that are most related to the concept that they are viewing when exploring through a brain, because if there are too many concepts in screen, users will lose their focus on the concept that they really want to know. And of course sometime users want to have an overall look to the whole brain. So system will provide an overall view of all the concepts of the brain in tree-structure.

3)   Content

Content, in this system, is a piece of text or a webpage that describes a concept from a certain angle. Users can not only add children concepts, but also add many contents to enrich a concept.

Not only can users use text in the content, but they can also insert images and videos in it to help understand the whole content. Link is another good content theme for describing concept, by adding links as contents, users can check the linked web pages as well as read the text conveniently.

B. Requirement Analysis

In this section, we put forward some requirements for the new system so that it can meet the previously mentioned system features.

1)   Create, modify, and delete brains

When doing knowledge management, users need to create their own topic maps. Each topic map is a tree-structured knowledge base, which is called brain in this system. A user can have multiple brains, and can also share their brains to others. Users are able to edit and view their own brains and public brains at any time.

2)   Add, modify, and delete concepts

A plump brain is composed of many concepts (topics). Each concept has its parent concept and children concepts, and they are similar concepts of parent node and children nodes in a tree structure. By continuously adding concepts to the brain, users can organize their mind and express their own knowledge in a certain field more clearly (the conversion process from tacit knowledge to explicit knowledge). Thus making the knowledge for their own use, and also helping to share knowledge with other users.

3)   Enrich concepts

The contents of each concept in a brain contain user's understanding of the concept. Users enrich concepts by adding contents of texts, images, videos and links to them or by adding children concepts to them. The enrichment of concepts is an important way of organizing one's mind, and it is also an important way of visualizing and presenting one's own knowledge to others. By enriching concepts, users can further expand their own knowledge base and make them into use when needed.

4)   View and search concepts

When a brain is completed, the main way of using it is indexing to one of the concepts to their related concepts and viewing contents of the concepts. Through a content display page with multiple tabs, various information belong to the concept can be presented to the user. Through a tree-structured interface that displays partial of the brain, users can concentrate on some key concepts they need. And if users need overall understanding of a brain, they can have a whole view of the brain and save the brain as an image. In addition, if the brain is large, doing hierarchical search will be time-consuming and laborious. Search function helps users locate the concepts or the keywords they need.

5)   Synchronize, share and collect brains

Knowledge sharing is really important because it induces people to capitalize on existing knowledge, accordingly promote people coming up with creative solutions [9]. If you do not share, knowledge will always be just your own. The exchange and sharing of knowledge is beneficial to not only the expansion of others' knowledge, but also the improvement of your own knowledge.

System provide synchronize function for users to be able to manage and view their brains on different devices without any trouble. Public function gives users ability to share their own brains and collect others' brains for exchange of knowledge (teaching or learning).

6) Collect and refer concepts

Users can also collect concepts of other brains and refer them into their own brains. When viewing others' brains, users may find some concepts those are really well described and want to add them to some of their own brains. Then they can just collect them and refer them in their own brains.

7) System ease of use

The system interface requires uniform style, consistent interface elements, smooth interaction process, convenient operation, and users understand accessibility. System provides shortcut to easily manage brains (including add, delete, collect, refer, rename and enter concept). Users can copy images or texts with format from other sources and paste them into the rich text editor. Users can also drag a concept to other places rebuilding the structure of the brain. Users should be able to easily figure out the structure of a brain by a tree structure visualization.

C. Preliminary Design

The system should be a web application. It contains at least two parts, database and web server. Database stores all the data created by users. Web server manages the whole system, provides user interface to users. Users use the web application by browsers, register and login to get all the services through webpages.

1) Business Overview and Logical Design

The system contains a database and a web server.

Database stores all the data created by users including users' login information, brains information, concepts information and contents information.

Web server provides user interface for users, converts users' actions into a series of database requests, processes database requests and displays the results to users.

Main requirements have been mentioned in the former sections. Here is how to use the system.

- All users should have their own account to use the system.

- Users can create new brains, view or edit their own brains by clicking corresponding icons in "Brains" tab.

- Users can view others' brains by checking collected brains and public brains.

- When users click into brains, they can view through concepts, search for the concepts those they want to learn about, read the content of the concepts they are interested in and have an overall view of the whole brain.

- When users click into brains that belongs to themselves, they can manage their brains by edit names, add, delete or edit concepts, add, delete or edit content, set brains to public or private, and also delete brains.

2) Technical Architecture (Figure. 1)

Technical architecture of the system has many layers.

Web browser (client) is the medium for information exchange directly with users. Users access all the webpages by browsers.
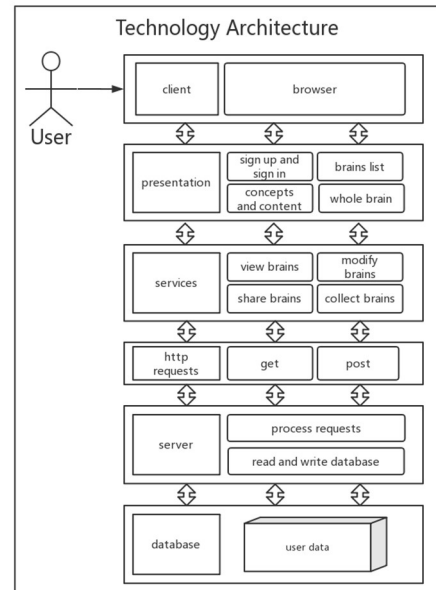

Fig. 1. Technical architecture

Browsers translate HTMLs to what users can understand (user interface) and show them to users. When users want to use services, they interact with the pages and browser convert those actions into http requests.

Http requests are sent to web server, web server process those requests and access the database, which stores all the user data. After database operations, web server response to the client with required data. Web browser process the received data into good shape and display it to users.

IV. SYSTEM IMPLEMENTATION

A. System and its framework

1) Web Server

This system is developed by Node.js. Using Express as the framework following MVC (Model-View-Controller) pattern.

Models contains all the methods for the server to access the database. It also does some logging works such as automatically adding views count after each "findById" method.

Controllers process http requests received from clients, do some authentication and then call the model methods to complete the database operations. Then response to the clients with necessary information. They manage users' sessions in order to avoid request abuse.

Views provide user interface. Web server render views to client browsers showing all the information they need. Views usually don't contain any logic in them.

2) Database

System's database is established on MongoDB, and mongoose is used to manage and access the database in web server. MongoDB is a NoSQL database. Because of quick iterations and frequent code pushes, using a NoSQL database is the best choice to lower the cost.

There are 4 tables in the database: user info table, brain info table, concept info table and content info table.

- User info table contains user's id, its username and password.

- Brain info table contains the user id who create the brain, brain's name, whether or not it is public, a list of user id indicates who collect this brain, its root concept's id, its version, created time, last updated time and views count.

- Concept info table contains the brain id of which brain it belongs to, its parent concept's id, its name, a list of user id indicates who collect this concept, referred concept id if it is referred from other concept, its version, created time, last updated time and views count.

- Content info table contains the concept id of which concept it belongs to, its name, its type (rich text or link), its content, its version, created time, last updated time and views count.

Server is built based on Node.js + Express + jade. Client part mainly uses jQuery, Bootstrap, Summer Note and jsMind as frameworks and plugins. Database is established on MongoDB, and mongoose is used to manage and access the database.

B. Functions Implementation

1) Sharing brains

In this system, each brain has a Boolean attribute called "is_public", its default value is false. When users open their own brains, there is a pair of buttons on the top of the screen enable users to change the attribute from false to true or from true to false. When users finished enriching brains, and want to share their brains to others, just set the brains into public mode, and all of the users can see them in the public brains list. (Figure. 2)
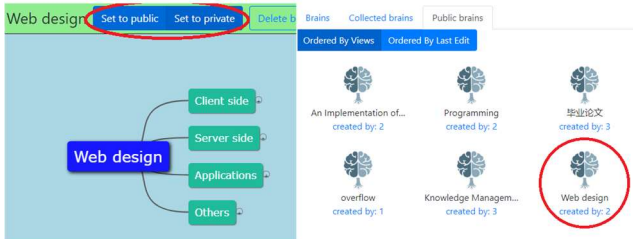

Fig. 2. GUI of sharing a brain

2) Organizing concepts

Users manage their knowledge in certain fields by organizing concepts in it. By adding concept nodes to the tree-structure and editing content of those concepts, users can gradually construct a valuable knowledge structure. Each change to the structure and content triggers an autosave action, system records all changes and submits unified requests to modify the database. (Figure. 3)
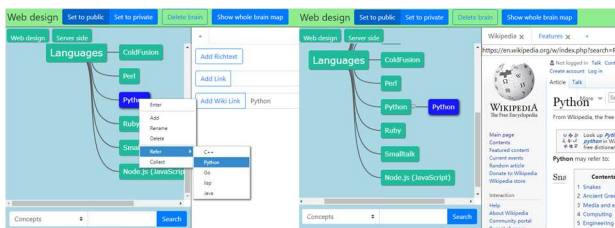

Fig. 3. GUI of referring a concept

TABLE I.   Systems Comparison

	New system	Wikipedia	Blog	Evernote	OneNote
Structure	Tree	Entries	Entries	Entries	Tree
Structure visualization	Part of the map	Text list	List	List	Tree view List
Structure modification	Easy	Hard	Hard	/	Hard
Search (title and content)	Both	Both	Both	Only title	Only content
Sharing (to person and public)	Both	Both	Both	Both, without platform	Only by email
Edit nodes	Normal	Hard	Normal	Easy	Easy

V. Discussion

In the discussion, we make a systems comparison among existing systems and our new system, and propose a simple case to study on the features on different systems.

A. Systems Comparison

Comprehensive analysis of some of the above knowledge management tools can summarize some of the current situation: There are many types of knowledge management tools. Some of them are biased towards sharing, some of them are focused on taking notes, some of them emphasis on the way of thinking, and others look for communication and studying.

As we can see in the TABLE I, those systems which emphasis on sharing are generally more convenient to view, but relatively more difficult for editing. Whether or not it is easy to learn and communicate depends mainly on whether the publisher (or editor) is good enough in his or her own ability to use his or her own way of organizing knowledge content for others to use. Those systems which concentrate on taking notes is relatively easier to edit the content, but most of them will not be able to quickly locate the parts that users need because of the poor visibility of the structure. And the new system seems to be a good solution of organizing and sharing knowledge, though it may not be the best choice for taking notes.

B. Case Study

We use the "Web design" knowledge structure with 5 layers and 55 nodes (which is already defined in Wikipedia) to evaluate our system.

1) Knowledge Structure Creation

Users may spend less time and energy on creating knowledge structure in the new system.

By using shortcuts, users can finish the whole task without leaving their two hands from keyboard. Navigating through nodes, add nodes and delete nodes, almost all the actions can be done through shortcuts. Of course if users are used to mouse, they can also finish most of the tasks only by mouse clicking.

In OneNote, users are often confused by how to add a section (node is called section in OneNote) to the right place. Because if there are many section groups, focus point in OneNote becomes weird so that you may spend a lot of time to adjust the sections you have added to fit your need. In Wikipedia and Blog, users usually have to create the content first, and then link it to a page that contains the outline of the

knowledge area. Constantly editing on different pages is often considered very difficult and time consuming.

2)   Node management
New system performs well for node managing.

For other systems, usually users have to think about how to build the whole structure first, sometimes they even have to prepare a draft for the structure designing. But in the new system, users usually you do not have to worry about making structure mistakes when constructing brains, because it supports flexible editing of the structure so that users can fix them quickly without any trouble. For example, you just finished editing the DHTML concept. And then you realized that it should be better to divide it into 3 sub-concepts: HTML, CSS and JavaScript. In OneNote, you have to delete the section first, because section cannot directly contains other sections. And then add a section group named DHTML, add 4 sections into the DHTML, the first one records the former content in DHTML section (section group has no content itself), and then edit other concepts.

 In the new system, you can just find the concept you want to add child in, press tab (shortcut for add child), everything is done.

3)   Knowledge sharing
The new system provides collect and refer functions for users to use existing knowledge rationally.

In OneNote, users can share their notes by emails. In Evernote, users can share their knowledge by links and work chats [9], but there is not a platform for publishing their notes and for all other users to access all published notes. And both of them have no referring function, users have to copy the information that they think valuable by themselves into where they think it may help.

New system provide easy way of knowledge sharing, by change the brain into public mode, it is available to anyone else in the public brains list. We can search for the brains they need through those brains. And also, we can collect every brain and concept that we are interested in, and we can check them or refer them into our own brains at any time. If referred concepts are edited by the creator, users will receive notices and decide to keep the original one or update to the new one.

4)   Knowledge visualization
Figure. 4 gives an easy structure visualization comparison image among the 3 systems. You can easily figure out the relationships between nodes with tree-structured concepts visualization (new system, upper left). But with the tree view list (OneNote, upper right), you have to look through all the sections in the same group to get the group name. And the text list (Wikipedia, below those two) can only show one layer of the structure and not that easy to look through nodes between layers.

C. Limitations

Of course there are still many limitations in this system. The biggest one is, this system cannot well represent knowledge relationships that are difficult to store using a tree structure. A lot of relationships cannot be divided directly into tree-structure because of the relationships between concepts in different branches.

Fig. 4.   Structure comparison screenshot

VI.   Conclusion

In this paper, we introduced the concept of knowledge management. Further, by analyzing people's needs and the advantages and disadvantages of existing systems, we proposed that it is necessary to develop a good system for sharing and organizing knowledge. Next, we introduced the design and implementation of a new system and evaluated it from different aspects. We found that the new system does perform better in some aspects to other systems. But we also found the system's limitations. Maybe find a good method to represent different kind of knowledge could be a good direction for further works.

References

[1] Jing Xiang, "Electronic government information", pp. 2-2, May 2005.

[2] Zhiping Yang, Jin Du, Hongpei Li, Chao Wang, Meng Yu, "Personal Knowledge Management Tools Overview", Knowledge Management Forum, vol. 2, pp. 9-15, 2013.

[3] Nima Jafari Navimipour, Yeganeh Charband, "Knowledge sharing mechanisms and techniques in project teams: Literature review, classification, and current trends", Computers in Human Behavior, vol. 62, pp. 730-742, May 2016.

[4] Bill Tancer, "Look Who's Using Wikipedia", Time, December 2007.

[5] Microsoft, "OneNote now on Mac, free everywhere, and service powered", Office Blogs. Microsoft, March 2014.

[6] Dongqing Lin, "Management information system : the strategic core competence of e-business", pp. 13-13, 2002.

[7] Wikipedia, "Concept", https://en.wikipedia.org/wiki/Concept, accessed in June 2018.

[8] Abraham Carmeli, Roy Gelbard, Roni Reiter-palmon, "Leadership, Creative ProblemSolving Capacity, and Creative Performance: The Importance of Knowledge Sharing", Human Resource Management, vol. 52, No.1, pp. 95-122, January 2013.

[9] Evernote Corporation, "Share notes", https://help.evernote.com/hc/en-us/articles/209005417-Share-notes