

# Collective Intelligence

## *How Collaborative Contents and Social Media Changing the Face of Digital Library*

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**Abstract:** The growth of digital libraries has provided useful resources for users. However most digital libraries are not effectively to promote themselves and engage audience. Limited resources also postponed the growth of the materials collection and expansion of related research and discussion. Our study shows how digital library can use social networking system to promote new material and engage user, allow user to share information and thoughts. It facilitates a collective intelligence system where user can interact and contribute in a knowledge sharing environment. In a platform for user-generated content, user can submit material and join discussion, and admin will learn the inputs and filter the content. This paper proposes the use of social networking system in digital library, delivers some case studies and explains how we can use social media to expand user base with recommender method. In this paper we also provide recommendations for further development.

## 1 INTRODUCTION

Many virtual intermediaries have been used to digitalized online archives, provided research-based file-sharing, and facilitated collective knowledge sharing in discussion forum. Levy and Marshall (1995) regarded that digital libraries are collections containing fixed, permanent documents which are based on digital technologies and are used by individuals working alone. We aim to improve the current involvement of collective knowledge sharing and social networking system for digital library in a context of open knowledgebase platform.

The current user involvement in digital libraries is still very low. Most institutions only provide static format of their digital library with little or no promotion to the students and visitors. Users find it hard to search for certain issue and since they rarely learn about digital library, there are very few people who are interested to explore it by themselves. Until now, digital library is still considered as a time-consuming research resources with limited advantages.

We aim to import social network system to

digital library, where users can easily find digital content, we can easily preserve the information and share it, and users will also be more involved in generating content, sending comments and feedback and exploring others' opinion about certain data. This will be a crowdsourcing method, where people from different locations can contribute together toward a cause for the community.

Boyd and Ellison (2007) mentioned that social network sites are web-based services that allow individuals to construct a public or semi-public profile within a bounded system, articulate a list of other users with whom they share a connection, and view and traverse their list of connections and those made by others within the system. In effect, social recommenders can leverage users' acquaintance with the recommendation source, which instantly attaches a wealth of established social information to the recommendations that can be further explored and exploited in the processes of inspection and control (Groh et al., 2012).

This means it's necessary to build a bounded connection, understand the needs, and know their connection with others. Collective intelligence characterizes multi-agent, distributed systems

where each agent is uniquely positioned, with autonomy to contribute to a problem-solving network (Gill, 2012).

Inside an e-learning scenario, the concept of digital library system naturally translates into a virtual environment, where interactions are welcomed and eased, and where every community service, like wikis and forums, contributes to the creation of a common knowledge as part of a structured learning process.

Digital library is one of the service for virtual learning and an innovative system of collective intelligence to make it easier for user to learn and promote online learning environment. Di Cerbo, Dodero, and Succi (2008) encouraged a virtual environment to facilitates community service such as e-learning service. In this paper, we find out how social networking approach can expand user base and encourage collective intelligence, which if executed properly, it will result in a series of up-to-date materials, new suggestions, amateur inputs in discussion related to subjects and cutting cost and effort to expand the collection while users offer new contents.

An interactive virtual medium will also connect different perspectives and resources in related fields and provide additional knowledge base necessary to expand research and discussion for the topic in question. Collaborative systems are tools used to facilitate the implementation of group work (Aparicio and Costa, 2012).

In this paper, we investigate some case studies about how social networking system deployment is visible for various uses such as digital library expansion and integrated collective knowledge base. Regarding to certain weakness in the application method so far, we plan an improved system for future work and explain the detail in architecture design. Finally we recommend some necessary suggestions for future expansion.

This paper consist of: Section 2 introduces collective intelligence use cases. Section 3 presents details of social networking system process and case studies of social networking involvement and recommender system. Section 4 explores how to combine social networking system with collective intelligence concept. Section 5 has an implementation plan, along with arcitecture design. Section 6 explains the recommendation for future work.

## 2 COLLECTIVE INTELLIGENCE USE CASES

In software development, collective intelligence offers a solution to complete a system or run analysis and maintenance in a cost-effective and time-effective way.

Collective intelligence approach has been used in web-based application and software engineering, where participants are engaged virtually to a global project that combines each of their work result to complete a database, or to construct a new system or expand and improve an already established system. Such projects can benefits a massive choices of ideas, technical support and knowledge base for some various participants, from amateur to professionals.

### 2.1 Knowledge Sharing in Informal Communication

The Tree of Knowledge (Kwon et al., 2011) is an enabling technology that helps people share their knowledge through their ongoing informal interactions with their colleagues in a specific place. It simulates the information-sharing environment where the interaction is projected as the tree withers and the leaves fall. The states of the tree environment, such as sunshine, windy, snowstorm, and other weather conditions, also depends on the level of interaction. When people approaches the tree, the client system will load the welcome page.

The current prototype of the Tree of Knowledge is a web-based distributed system consisting of multiple clients, a data server, and the tree system. The client side's user interface displays the postings and a textbox to post a message. When the users post their knowledge including ideas, questions, comments, critiques, notes, and random thoughts, the location tag is automatically attached and the user-defined tags can be attached to the message.

### 2.2 Personalized Ebooks Learning Application

Social network growing features keep on providing users with new medias to interact and learn. Ribière, Picault, and Squedin (2010) developed an application to facilitate cross-media and cross-community information discovery; facilitate information discovery with contents of all sorts

from all sources; extend the e-book concept to be a dynamic collection of multimedia contents from all sources and extend reading to discovery for formal, leisure and spontaneous browsing and learning. The system finds users of the social network of the book that have annotations in common. Then it analyzes sequences of annotations of those people, compares them with the sequence of annotations each user made, and at the end, suggests possible next steps within the book, in terms of contacting opportunities or reading opportunities.

### 3 RECOMMENDER SYSTEMS IN SOCIAL NETWORKING

As an effective social networking method, voluntary social campaign is also similar as recommender system. Recommender system is a system that suggests certain materials for a user in the acknowledgement that the user in question has read, explored, searched, and discussed about a related topic. While one method uses real user and another one uses an machine-based automate approach, both manage to generate more users to increase our user base, and in return, give a bigger chance to collect more resources through user-generated content uploads.

#### 3.1 RecDB: Social Recommender System

The main purpose of recommender system named RecDB is to suggest users with useful and interesting items or content (data) from a considerably large set of items (Sarwat and Mokbel, 2012). RecDB is an efficient and scalable system that provides online recommendation to users. Online recommendation viewed by users comes from the system function inside the database engine. The module, Rec-tree, a multi-dimensional tree index structure that is built specifically to index recommendation models and provide flexible and online recommendation to users. As in traditional database index structures, the user can define which users/items attributes (i.e., dimensions) are needed to be indexed by Rec-tree.

#### 3.2 Tasteweights Music Recommendation Tool

Social recommendation spreading information to

virtual friends, and often the information details depend on how close in the relationship between users. Bostandjiev, O'Donovan, and Höllerer (2012) studied this approach by developing TasteWeights, a social recommender tool. The TasteWeights system recommends new artists/bands based on the music "likes" of the user and her Facebook friends. TasteWeights system displays a graph that shows the users' items, their friends, and the recommendations. By clicking at the graph, the connections between these entities can be explored. The system also shows a short description for each recommended band/artist.

The system allows two types of controls over the recommendations: users can adjust the weights of their items and their friends (initially weighted by similarity). By changing the weight of your friend, the system will recognize the change and calculate your friend overall compatibility match with you, and in return show whether that friend is closer to you in term of interest and closeness, or farther.

### 4 SOCIAL NETWORKING SYSTEM FOR COLLECTIVE INTELLIGENCE

In a collective intelligence environment, collaborative content can gain more exposure in a user group that is interested in the subject. Each user has a connection with another user inside or outside his group, making it possible for him to receive suggestion on recommended item from different perspective, and easy to discuss variety of topics with people from different views. We can benefit from this system by connecting users and encouraging users to contribute in discussion and share useful materials.

The converse is 'crowd' intelligence, typified by independent persons, often unknown to each other and always uninfluenced by each other. This offers a unique approach of information harvesting for a diverse audience, aim to design a system with many features, four of which are outlined as follows (Keller, 2011).

VoiceView application combines social network with collective intelligence with these features:

The first is to have effective individual incentive, organizational structures and information technology tools.

The second is to pull together distributed

knowledge within communities that are trying to solve practical problems combining them into something useful.

The third is to ensure that error correction exceeds the rate of error introduction as the system learns. It means while we are tracking errors that occurs when the system learns the tasks, we should gradually improve the system and fix the errors, so there are some fixes for the remaining errors.

The fourth is to maintain the process sustainably. It is targeted to handle the information processing issues which include algorithms and the associated structures and incentives that make the algorithm function in the real world.

Among the flowing data and masses contribution, the system faces challenges to give a valid value and identify a particular contribution. First, how we can encourage user contribution. We can setup a badge system where user will have a level. And second, how we can filter and track all the contents and annotations that user sends, including checking comments. We would apply points system to encourage users' contribution. Each time they refer new friends or upload an acceptable content, or contribute by sharing useful comment and annotation, they will receive points. Once the points reach certain amount, their will get upgrade to the next level. User with high level will get more exclusive access to new contents, private discussion forum, and will get a new badge icon in their profile.

## 5 IMPLEMENTATION

In our digital library, multimedia files and text materials are saved in a web-based database distributed system, and each material is viewed in a specific webpage for the material, also known as item or item webpage. Each of these webpages contains the picture of an item and explanation, and, additionally, embbed multimedia content or references links.

Each item page has annotation suggestion form, social bookmarking button so users or non-registered visitors can share links with their own social media account, and a comment column where users can discuss about the item and related topics.

For quality control, it is necessary to authorize each user input such as comments, files and annotation suggestions. Admin authorization works by tracking content and annotation, tracking users' and groups' behavior, filtering spam content and publishing validated inputs. After filtering and authorizing, admin will publish the item page links in various social media sites using our own accounts. Admin creates trailer or samples for video and audio files, which will be uploaded to video or audio sharing sites in our own channel.

Table 1: User Collective Intelligence Process.

| Users' role:                                                                                       | Contribution:                                                                                                                                                                                                                   | Nature of contribution                              |
|----------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------|
| A. Users are 'information providers'; user supply content and structure is not specified.          | <ul style="list-style-type: none"> <li>_ Creating blogs</li> <li>_ Creating wikis</li> <li>_ Uploading multimedia objects</li> </ul>                                                                                            | Time Asynchronize, unstructured, public             |
| B. Users provide unstructured responses to existing content published by the information provider. | <ul style="list-style-type: none"> <li>_ Commenting on items (reviews, thoughts, idea)</li> <li>_ Annotating online texts</li> <li>_ Uploading multimedia objects</li> </ul>                                                    | Time Asynchronize, unstructured, public and private |
| C. Users provide structured responses to existing content published by the information provider.   | <ul style="list-style-type: none"> <li>_ Ranking items on a scale</li> <li>_ Answering multiple-choice opinion surveys</li> <li>_ Uploading multimedia objects</li> </ul>                                                       | Time Asynchronize, structured, private              |
| D. Users create links between materials                                                            | <ul style="list-style-type: none"> <li>_ Tagging objects</li> <li>_ Annotating objects with links</li> <li>_ Sharing links (over social network, email, etc.)</li> </ul>                                                        | Time Asynchronize, structured, public               |
| E. Users browsing activities for personal benefit.                                                 | <ul style="list-style-type: none"> <li>_ Creating personal (private) pages</li> <li>_ Uploading multimedia objects</li> <li>_ Tagging objects within a personal space</li> <li>_ Linking items (private bookmarking)</li> </ul> | Time Asynchronize, unstructured, public             |
| F. Users contribute to our database                                                                | <ul style="list-style-type: none"> <li>-Upload files</li> </ul>                                                                                                                                                                 | Time Asynchronize, structured, private              |

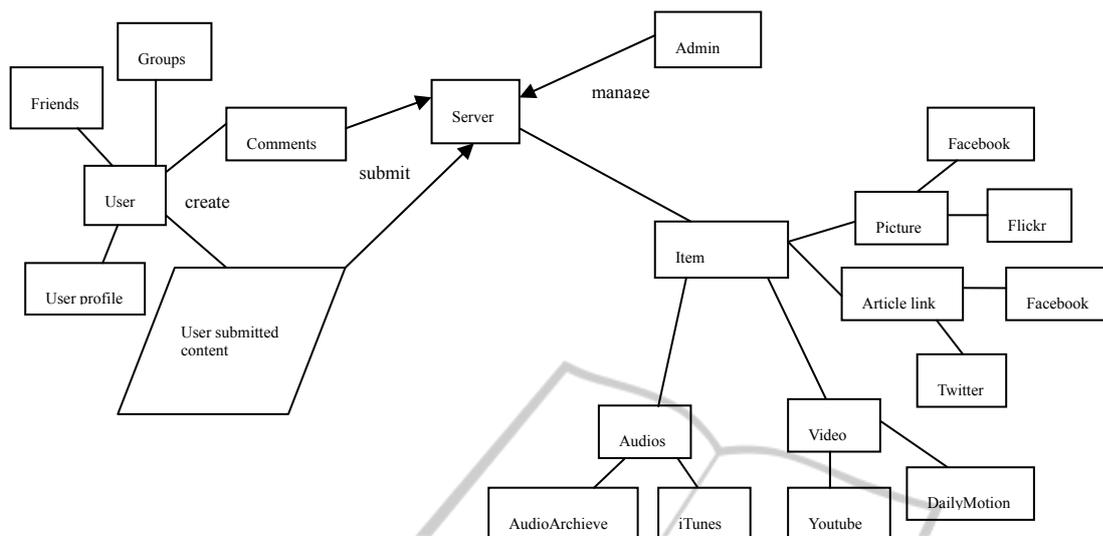


Figure 1: Digital Library System with Collective Intelligence.

Digital library management task list including:

1. Identify user interest and personality
2. Identify users/groups with similar interests
3. Manage discussion
4. Track content trends
5. Suggest user to share links that they like with their friends
6. Trigger voluntary social campaign

Voluntary social campaign is a recommending process where user is genuinely interested with certain subjects, webpage or document and shares the links in their social media account and by email to their friends or colleagues. In our digital library, users can also share links to other users inside their friends list or inside their group. By attracting more users, we have more chances to gather more user-generated content. Users can use discussion feature, share thoughts in comments section in each item page. Discussion forum lets users talk about a particular topic and interact with each other, express agree or disagree for each other comment. Users will have a limited space private message box to send message to their friends. Each user has a personal page where they can see their friend list and group list. While users browse inside digital library and find someone or some groups with similar interest or intellectual level, they can join that group, or invite this person in question to be a friend.

Outside the digital library, users share the links of their favorite item pages in their social media accounts. They can also follow our twitter account, YouTube channel, and promote it to their friends inside that social media site. If they think their

friends will benefit from our digital library as a whole, they can share the main page links with social media accounts or email to their friends/colleagues. Additionally, we also promote our own social media accounts by uploading educative and attractive content in various formats, such as audio files in iTunes, video in YouTube channel, introduction to historical items in SlideShare presentation, pictures of items in SlideShare presentation, pictures of items in Flickr and Picasa, and publish some free trial documents as a sample of our content, in some file-sharing sites.

## 6 CONCLUSIONS AND FUTURE WORK

Collective intelligence will provide a resourceful virtual environment where user can save time and effort to find necessary information in their field. Additionally, it is also a platform to discuss and exchange their thoughts with other scholars and professionals with experiences in the topic in question. Our digital library will be a place where people can find a community to learn and share knowledge and materials, and their contribution will benefit every reader.

For future use, we recommend to keep filtering users that registering. We should also track content, including content that users upload and comments that they write inside the item page, and also track and filter the annotations that they suggest for the item. Filtering process means to authorize which content that is topic-related, useful, and written or

presented properly. Another necessary work is to update the news, discussion topics and content in our social media accounts. When there is an important new content for a particular subject category in our digital library, we can also put the news in social media. By updating our social media news, filtering user-generated content and encouraging users' discussion both in our digital library and in our social media page, we create a sustainable collective intelligence system.

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