SocialPathFinder: Computer Supported Exploration of Social Networks on WWW

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The exploration of social networks is essential to find capable collaborators who can help problem-solving. This paper proposes an Internet and WWW based application, called SocialPathFinder, for seeking for a collaborator with the chain of personal connections (PeCo) in WWW. Moreover, this system helps gathering, exploring, and visualizing social networks. The experimental results show that the system facilitates that learners encounter collaborators and develop a new helpful relationship beyond the classroom.
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1. Introduction

Recently, opportunities for communication and collaboration via computer networks have immensely been increased in networked societies[11]. A fundamental problem is how to encounter people who can help problem-solving. We are focusing on the problem of discovering such people through social networks. Social networks are at least as important as the official organizational structures for tasks ranging from immediate, local problem solving (e.g., fixing a piece of equipment), to primary work functions, such as creating collaborative groups[5].

In CSCW (Computer Supported Cooperative Work), researchers are interested in the role of social networks between organizational members. Clement stated that users developed informal collaborative networks to know how to use a new[1]. Then, private networks are important for workers to solve problems by providing helpful information. A number of studies have shown that one of the most effective channels for gathering information and expertise within on an organization is its informal networks of collaborators, colleagues and friends. The networks of helping relationships are called "***Help Network***"[2]. However, the networks are not collected and generally follow work group alignments rather than technical specialization. Therefore, it is significant to use members' interpersonal connections effectively in their activities.

In CSCL (Computer Supported Collaborative Learning), one common component of collaborative learning is the "***informal peer-help networks***". This notion is compatible with Wenger's communities of learners[12], where people who share learning goals within an authentic learning environment can develop ties that reinforce learning outcomes. From this viewpoint, Greer et al.[4] proposed PHelpS (Peer Help System) that supports workers as they perform their tasks, offers assistance in finding peer helpers when required, and mediates communication on task-related topics. On the other hand, our approach focuses on how a system can support both storing and exploring "***social networks***" for finding a capable collaborator who is close to a learner.

In particular, expert cooperation is often needed to achieve tasks that require extensive knowledge in a collaborative learning environment where frequently a learner needs to obtain information that is concerned with his/her researches. The learner may seek advice

from his/her social network. There are many possible sources for determining direct relationships. The initial version of our system imposed the entry of relationship lists upon organizational members[7]. The provision of individual ties makes the burden heavy for the users. Schwartz and Wood[10] proposed a way to obtain relationships by analyzing e-mail logs. However, the use of such information raises concerns of privacy and security. Therefore our system uses the co-occurrence of names in close proximity with any documents publicly available on the World Wide Web (WWW) as evidence of a direct relationship. Such sources include links found on home page and organization charts.

The purpose of the system is to create a tool to help people find the social networks in which they take part, so that they can quickly find short referral chains between themselves and experts on arbitrary topics. The process of finding an expert who is both reliable and likely to respond to the user can be viewed. The system structures a social network model based on the result. The network model is used to guide the search for people or documents in response to user queries. It is that a user interactively explores a graphic representation of the portion of the network centered on himself or herself. This information can be used in several ways. For example, the user can directly contact one of the experts who are likely to response.

ReferralWeb[6] system uses the co-occurrence of names in close proximity in any documents publicly available on the Web as evidence of a direct relationship. The system beforehand gathers the co-occurrence of names in close proximity in any documents publicly available on the WWW as evidence of a direct relationship. Such sources include links found on home pages, lists of co-authors in technical papers and citations of papers, exchanges between individuals recorded in net-news archives, and organization charts (for example, for university departments). However, the relationships often change with time. Therefore, we attempt to develop a system for seek referral chains at real time.

2. Overview of SocialPathFinder

First, a user registers both URL of his/her own home page and keywords as topics s/he interested in. The system accepts several keywords. Of course, one keyword is enough for the system to explore social networks. Figure 1 shows the interface for entering a query on our prototype system. We entered as the URL of the user's own home page:
http://www-yano.is.tokushima-u.ac.jp/member/fukui/, as the keyword Java and as network radius 2.

Secondly, the system explores social networks from a web page that a user registered as a starting point using the following method:

(1) Extracting organization charts if they exist

We consider that there are relationships between people who belong to the same division of a company or the same laboratory.

(2) Extracting personal links

There is, of course, strong relationship between friends, parents and children, relatives.

(3) Finding information about such things as individual interests or knowledge about analyzing his or her own web pages:

This information is necessary to judge if one is suitable as expert cooperator or not. The system finds individuals who are concerned the user, finally the system finds expert as cooperators. The system structures a network model based on the result, and shows the user structured network model as a graph. Figure 1 shows the system's response. 14 individuals were extracted, and 4 experts were found (ogata, okawa, takahasi, sueda). Numerals can be seen the next to the individuals names. They show the number of keywords an individual web page contains. For example, it shows that all Ogata's web pages contain 31 keywords, and after the system finished exploring it found 27 keywords in Takahashi's web pages.

Moreover this number lets the user know which expert has knowledge related to predetermined thus enabling the user to know which expert should be contacted.

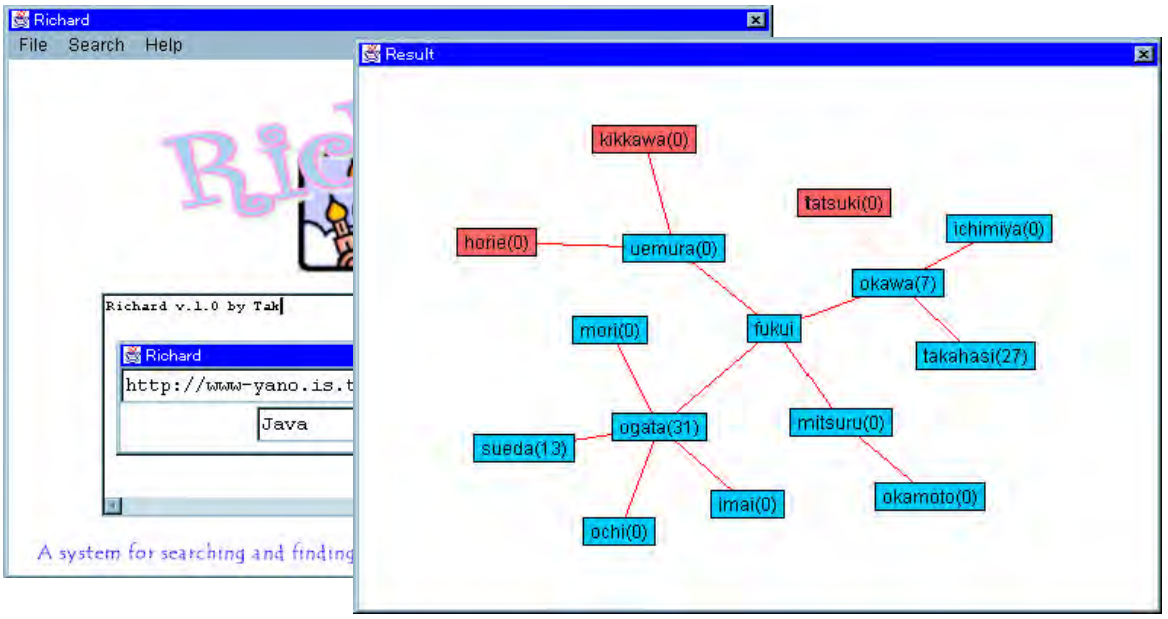

Figure 1. Example of a query to the system.

3. Method of Social Network Exploration

The system first downloads the web page that the user registered, afterwards the system screens comparing "href" as keyword. The system finds hyperlinks from web pages like following examples. Let's suppose that the system downloads the following web pages:
http://www-yano.is.tokushima-u.ac.jp/member/fukui/index.html
The system then finds five hyperlinks: (1) profile.html, (2) ../index.html, (3) /research/index.html, (4) http://www.yahoo.com/, (5) mailto:fukui@is.tokushima-u.ac.jp .
These links are incomplete as the uniform resource locator (URL), however. The system remembers the URL of starting point that the system can restore four complete URL comparing with the URL of starting point. And we now describe that "mailto:fukui@is.tokushima-u.ac.jp" is not a hyperlink but an e-mail address, thus the system obtains "fukui@is.tokushima-u.ac.jp" as an e-mail address of the owner of this web page, and when the system judges if the owner of a web page is individual or not it is used later. For example, http://www-yano.is.tokushima-u.ac.jp/member/fukui/profile.html ...(1)
The system next classifies these URLs into following three categories:

(a) The web pages that the individual owns
When the web page is on the same site, we define it "the web pages that the individual owns".

(b) The other web pages that exists on the same site
When the web page is on the same site and the individual does not own, we define it "the other web pages that exists on the same site".

(c) The other web pages
When the web page is not on the same site, we define it "the other web pages".

The system then extracts organization charts; we describe later other, if it exists to refer web pages which come under (b). At the same time the system extracts personal relationships to analyze web pages which come under (c). When the system finishes analyzing web pages, the system then analyzes a web page that comes under (a). When all web pages have been extracted and no page which have to be explored exists, the system quits. We note that currently our system can not distinguish between different individual

with the same name.

In our system, the organization chart is defined as:

(1) Most of the links that appear in the web page expected organization chart are the same site. We think that organization chart and most of the people who belongs to the same division or the same laboratory have a web page on the same site.

(2) Domain name of the site is "ac" or "co". We suppose that the social relationship between people who have their own home pages on the server which domain name is "ne" or "or" are not strong.

At first the system explores WWW from the web page the user registered, and specifies found web pages. The system then analyzes hyperlinks from the web pages that come under (b) again, and counts the total amount of hyperlinks from the web page and amount of hyperlinks to the same site as the web page. After that, the system calculates the number of hyperlinks to the same site as the web pages are divided by the number of hyperlinks to the same site as the web page is. If the value satisfies the criterion, the system supposes this web page organization chart. The system extracts organization charts like this, the system supports that between people whose web home pages are linked from an organization chart.

4. Conclusion

This paper described an Internet agent based information system, called SocialPathFinder, for finding social networks on WWW. The method of analysis of judging if the owner of web pages is individual or not. And we tested out our theories by experiments with our system. Furthermore, we also described results and discussion of the experiment. In the future work, we will attempt to evaluate this system in heterogeneous classrooms practically.

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