View metadata, citation and similar papers at core.ac.uk

brought to you by CORE

provided by Universiti Putra Malaysia Institutional Repository

UNIVERSITI PUTRA MALAYSIA

AN AGENT-BASED SYSTEM WITH PERSONALIZATION AND INTELLIGENT ASSISTANCE SERVICES FOR FACILITATING KNOWLEDGE SHARING

NURFADHLINA BT MOHD SHAREF

FSKTM 2006 5

AN AGENT-BASED SYSTEM WITH PERSONALIZATION AND INTELLIGENT ASSISTANCE SERVICES FOR FACILITATING KNOWLEDGE SHARING

NURFADHLINA BT MOHD SHAREF

MASTER OF SCIENCE
UNIVERSITI PUTRA MALAYSIA

2006

UPM

AN AGENT-BASED SYSTEM WITH PERSONALIZATION AND INTELLIGENT ASSISTANCE SERVICES FOR FACILITATING KNOWLEDGE SHARING

By

NURFADHLINA BT MOHD SHAREF

Thesis Submitted to the School of Graduate Studies, Universiti Putra Malaysia, in Fulfilment of the Requirement for the Degree of Master of Science

July 2006

UPM

This thesis is dedicated to those who have inspired me…
Thank you for your support….

Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfilment of the requirement for the degree of Master of Science

AN AGENT-BASED SYSTEM WITH PERSONALIZATION AND INTELLIGENT ASSISTANCE SERVICES FOR FACILITATING KNOWLEDGE SHARING

By

NURFADHLINA BT MOHD SHAREF

July 2006

Chairman : Associate Professor Mohd. Hasan Selamat

Faculty : Computer Science and Information Technology

The scenario of distributed knowledge in organization, lack of understanding of knowledge sharing benefits and technology inadequacies are the main barriers to knowledge sharing facilitation. A more user-centered application through personalization and intelligent assistance technique are identified as the evolution in knowledge sharing facilitation research.

As response to these challenges, this study is dedicated to approach knowledge sharing facilitation with an agent-based system. Agent technology is a promising solution to knowledge sharing facilitation. Agent technology could provide personalization and intelligent assistance to give a more human-centered approach towards users in knowledge sharing participation.

This thesis focuses on automatic interest identification and knowledge member recommendation in order to reduce user's tasks and ease them to participate in

knowledge sharing. The proposed agent based system is called KSFaci (**K**nowledge **S**haring **Faci**litator). KSFaci provides personalization and intelligent assistance to users by offering knowledge member recommendation according to their interest preferences. This timely action gives users resources to find help and they can interact with each other to share or exchange knowledge.

The first agent, Profiler is able to monitor user navigational behavior and build user profile on behalf of the user. The Recommender agent then determines the user's most preferred interest and matches them against other users sharing similar interest. The main algorithms used are profile determination and user similarity. The recommendation services provided reduce users burden from manual browsing and searching for knowledge reference resources. KSFaci is embedded in web environment and is implemented using Java Servlet and runs under Apache server.

The performance of KSFaci is evaluated using a four-factor evaluation metrics covering the user profile preciseness, recommendation service, staff directory and document repository. Several techniques have been used including weighted respond analysis, two-point scale, Likert-scale survey analysis and overlap analysis.

User satisfaction result indicate that the agent-based approach used; by identifying user's interests and establishing knowledge network based on interests of its users is capable in facilitating knowledge sharing. In conclusion, the recommended knowledge network created based on the automatic interest identification has now become medium for users to refer for knowledge sources and later perform knowledge sharing tasks.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia
sebagai memenuhi keperluan untuk ijazah Master Sains

SISTEM BERASASKAN AGEN DENGAN SERVIS PERSONALISASI DAN BANTUAN PINTAR UNTUK MEMUDAHCARA PERKONGSIAN PENGETAHUAN

Oleh

NURFADHLINA BT MOHD SHAREF

JULAI 2006

Pengerusi : Profesor Madya Mohd. Hasan Selamat

Fakulti : Sains Komputer and Teknologi Maklumat

Senario pengetahuan yang teragih dan tidak terurus di dalam organisasi, kurangnya kesedaran tentang faedah perkongsian pengetahuan, dan kurang kesesuaian teknologi merupakan halangan utama kepada pemudahcaraan perkongsian pengetahuan Aplikasi yang berpusatkan pengguna melalui personalisasi dan teknik bantuan pintar dikesan sebagai evolusi dalam kajian pemudahcaraan perkongsian pengetahuan.

Sebagai tindakbalas kepada permasalahan tersebut, kajian ini menjurus kepada pemudahcaraan perongsian pengetahuan dengan sistem berasaskan agen. Teknologi berasaskan agen menjanjikan penyelesaian kepada persoalan pemudahcaraan perkongsian pengetahuan. Teknologi agen mampu menyediakan servis personalisasi dan bantuan pintar kepada pengguna dalam penerlibatan perkongsian pengetahuan.

Tesis ini memfokuskan kepada pengesanan minat secara otomatik dan pengesyoran secara otomatik rakan yang mempunyai minat yang sama. Sistem berasaskan agen

yang dicadangkan di sini dikenali sebagai Pemudahcara Perkongsian Pengetahuan (KSFaci). KSFaci menyediakan servis personalisasi dan bantuan pintar dengan cara mengesyorkan pengguna rakan pengetahuan bersesuaian dengan minat pengguna pada sesuatu masa. Dengan cara ini, pengguna memperoleh sumber pertolongan bagi menyelesaikan masalah dan dapat berinteraksi dengan rakan yang dicadangkan untuk bertukar atau berkongsi pengetahuan.

Agen yang pertama dikenali sebagai Pemprofil dan berkebolehan untuk memantau aktiviti navigasi pengguna dan seterusnya membangunkan profil pengguna untuk pengguna tersebut. Ejen Pengesyor kemudiannya memilih minat tertinggi pengguna dan memadankannya dengan pengguna lain. Algoritma yang digunakan adalah mengenalpasti profil untuk pengguna dan pengiraan persamaan pengguna. Servis pengesyoran yang diberikan mengurangkan beban pengguna daripada perlu mencari sumber rujukan pengetahuan secara manual. KSFaci dilarikan dalam pesekitaran sesawang menggunakan Servlet Java dan pelayan Apache.

Prestasi KSFaci dinilai menggunakan metric penilaian empat-faktor yang meliputi ketepatan profil pengguna, servis pengesyoran, direktori staf dan gedung dokumen. Beberapa teknik digunakan termasuklah analisis tindakbalas berpemberat, analisis dua-skala, analisis tinjauan berskala Likert dan analisis pertindihan.

Keputusan kepuasan pengguna menunjukkan bahawa pendekatan berasaskan agen yang digunakan; melalui pengenalpastian minat pengguna dan pembentukan lingkaran pengetahuan berdasarkan minat pengguna berkemampuan dalam memudahcara perkongsian pengetahuan. Kesimpulannya, lingkaran pengetahuan

yang diwujudkan berdasarkan pengenalpastian otomatik minat telah menjadi wadah pengguna untuk merujuk kepada sumber pengetahuan dan kemudiannya melaksanakan perkongsian pengetahuan.

ACKNOWLEDGEMENTS

Alhamdulillah, I have finally completed this work. With a deep sense of gratitude, I wish to express my sincere thanks to my supervisors, Assoc. Prof. Hj. Mohd. Hasan Selamat, Assoc. Prof. Dr. Mohd Nasir b Hj. Sulaiman and Pn. Wan Nurhayati b. Wan Ab. Rahman, for their immense help in guiding and supervising me throughout completing this research work.

Many thanks go to my colleagues and fellow friends for the help extended to me when I approached them and the valuable discussion we had during the course of research. The cooperation I received from other faculty members is gratefully acknowledged.

I would like to share this moment of happiness with my parents Mr. Mohd. Sharef b. Kamaruddin and Mrs. Ramlah bt Alias, my parents, who taught me the value of hard work by their own example. I would also like to extend my special thanks to my sisters and brother for supporting and understanding my situation. Without their loving support and understanding I would never have completed my present work.

This episode of acknowledgement would not be complete without the mention of my beloved husband Mr. Rosdiadee for his patience constant encouragement He rendered me enormous support during the whole tenure of my research. I am grateful for the inspiration and moral support he provided throughout my research work.

Finally, I would like to thank all whose direct and indirect support helped me completing my thesis in time.

Nurfadhlina bt Mohd Sharef

July 2006

I certify that an Examination Committee has met on 3rd July 2006 to conduct the final examination of Nurfadhlina bt Mohd Sharef on her Master of Science thesis entitled "An Agent-Based System With Personalization and Intelligent Assistance Services for Facilitating Knowledge Sharing" in accordance with Universiti Pertanian Malaysia (Higher Degree) Act 1980 and Universiti Pertanian Malaysia (Higher Degree) Regulations 1981. The Committee recommends that the candidate be awarded the relevant degree. Members of the Examination Committee are as follows:

Hjh. Fatimah Dato' Ahmad, PhD
Associate Professor
Faculty of Computer Science and Information Technology
Universiti Putra Malaysia
(Chairman)

Shyamala C. Doraisamy, PhD
Lecturer
Faculty of Computer Science and Information Technology
Universiti Putra Malaysia
(Internal Examiner)

MASRAH AZRIFAH AZMI MURAD, PhD
Lecturer
Faculty of Computer Science and Information Technology
Universiti Putra Malaysia
(Internal Examiner)

Rose Alinda Alias, PhD
Professor
Faculty of Computer Science and Information Science
Universiti Teknologi Malaysia
(External Examiner)

_____
HASANAH MOHD. GHAZALI, PhD
Professor/Deputy Dean
School of Graduate Studies
Universiti Putra Malaysia

Date:

This thesis submitted to the Senate of Universiti Putra Malaysia and has been accepted as fulfilment of the requirement for the degree of Master of Science. The members of the Supervisory Committee are as follows:

Mohd. Hassan Selamat, M. Sc.
Associate Professor
Faculty of Computer Science and Information Technology
Universiti Putra Malaysia
(Chairman)

Md. Nasir Sulaiman, PhD
Associate Professor
Faculty of Computer Science and Information Technology
Universiti Putra Malaysia
(Member)

Wan Nurhayati Wan Ab. Rahman, M. Sc.
Lecturer
Faculty of Computer Science and Information Technology
Universiti Putra Malaysia
(Member)

_____

AINI IDERIS, PhD
Professor/Dean
School of Graduate Studies
Universiti Putra Malaysia

Date:

DECLARATION

I hereby declare that the thesis is based on my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously or concurrently submitted for any other degree at UPM or other institutions.

_____

NURFADHLINA BT MOHD SHAREF

Date: 3rd July 2006

TABLE OF CONTENTS

	Page
DEDICATION	ii
ABSTRACT	iii
ABSTRAK	v
ACKNOWLEDGEMENTS	viii
APPROVAL	ix
DECLARATION	xi
LIST OF TABLES	xiv
LIST OF FIGURES	xv
GLOSSARY OF TERMS	xvii
CHAPTER	
1 INTRODUCTION	
1.1 Background	1
1.2 Problem Statement	5
1.3 Research Question	5
1.4 Objective	6
1.5 Scope	6
1.6 Research Methodology	7
1.7 Contributions of the Research	7
1.8 Thesis Organization	8
2 LITERATURE REVIEW	
2.1 Introduction	10
2.2 Knowledge Management System	11
2.3 Knowledge Sharing	12
2.4 Personalization Issue in Knowledge Sharing	16
2.5 User Model	17
2.6 Knowledge Network Recommendation	18
2.7 Agent-based Knowledge Sharing Development Framework	20
2.8 Summary	22
3 METHODOLOGY	
3.1 Introduction	25
3.2 Research Approach Justification	25
3.3 Experimental Setup	27
3.3.1 Objective	29
3.3.2 Sample	29
3.3.3 Instrumentation	29
3.3.4 Data Collection	30
3.3.5 Data Analysis	34
3.4 Experiment Remarks	36
3.5 Summary	37

4 SYSTEM DESIGN
4.1 Introduction 38
4.2 KSFaci Framework 38
4.3 KSFaci Development Stages 40
4.3.1 Knowledge Sharing Facilitation Requirement Specifications 41
4.3.2 Identifying the system's goals 44
4.3.3 Analyzing agent's functionalities 45
4.3.4 Detail Agent Design 47
4.2.5 KSFaci Topology and Coordination 52
4.4 KSFaci Algorithm 53
4.4.1 User activation algorithm 54
4.4.2 updateInterest algorithm 55
4.4.3 Most preferred interest recommendation algorithm 56
4.4.4 Similar interest member recommendation algorithm 56
4.4.5 Similarity with other users recommendation algorithm 57
4.5 Summary 57

5 RESULTS AND DISCUSSION
5.1 Introduction 59
5.2 KSFaci Implementation 59
5.2.1 User Login 60
5.2.2 Interest Registration 60
5.2.3 Most preferred interest recommendation 61
5.2.4 Member recommendation based on similarity in user profile 62
5.2.5 Member recommendation based on shared most preferred interest 63
5.2.6 List of users' interest 64
5.2.7 Upload Page 65
5.2.8 Search Page 66
5.2.9 Document Repository 67
5.2.10 Agent Recommended Interest Evaluation 68
5.2.11 System Overall Evaluation 70
5.3 Experiment Results and Observations 71
5.3.1 Interest Dataset 71
5.3.2 Survey Results 72
5.3.3 Profiling Ability 74
5.3.4 Recommendation Ability 76
5.3.5 Staff Directory 76
5.3.6 Document Repository 76
5.4 Summary 77

6 CONCLUSIONS AND RECOMMENDATIONS
6.1 Introduction 80
6.2 Limitations and Weaknesses 82
6.3 Future Enhancements 83

REFERENCES 84

BIODATA OF THE AUTHOR 89

LIST OF TABLES

Table		Page
2.1	Knowledge Sharing Tools	15
3.1	Research Objective and Methodology	26
3.2	User Profile Factor Question	32
3.3	Recommendation Factor Questions	33
3.4	Staff Directory Factor Questions	33
3.5	Document Repository Factor Questions	34
3.6	Satisfaction scale used for questionnaire results	36
3.7	Significance Scale	36
4.1	ProfileMonitor Functionality	46
4.2	MostInterestRecom Functionality	46
4.3	SimWAllUserFunctionality	47
4.4	MostInterestMember Functionality	47
4.5	LoadProfile Functionality	47
4.6	AddInterest Functionality	47
4.8	Profiler Descriptor	52
4.9	Recommender Descriptor	53

LIST OF FIGURES

Figure		Page
3.1	KSFaci evaluation metrics	31
3.2	Rating Scale to Measure User Satisfaction	35
4.1	The Framework of KSFaci	40
4.2	KSFaci Development Phase	40
4.3	Components in Knowledge Sharing Facilitation by KSFaci	44
4.4	KSFaci Goal Overview Diagram	45
4.5	KSFaci Functionalities Diagram	46
4.6	Personalization Service in KSFaci	49
4.7	User model attributes	50
4.8	Representation of user's interest in user profile	50
4.9	System Overview Diagram	52
4.10	User Activation Algorithm	56
4.11	updateInterest Algorithm	57
4.12	recommendMostInterest Algorithm	58
4.13	Similar Interest Member Recommendation Algorithm	58
4.14	Similarity with Other Users Recommendation Algorithm	57
5.1	Login page	62
5.2	Interest Registration	63
5.3	Most preferred interest recommendation	64
5.4	Interest Member page	65
5.5	My Member page	66

Figure		Page
5.6	Browse Users page	67
5.7	Upload Page	68
5.8	Meta-search engine page	69
5.9	Document Repository	70
5.10	Agent-recommended interest feedback	71
5.11	Overlap Analysis on Agent-identified Interest and User-selected interest	72
5.12	Overall evaluation	73
5.13	Interests captured through various modes	74

GLOSSARY OF TERMS

Autonomous behaviour	Ability of the system to make recommendations to users without being instructed by the user. The agents make recommendation based on it's knowledge about user's preferences.
Intelligent assistance	Ability of the agent to provide recommendation to users based on the agent's own perception developed through it's monitoring of user's behaviours.
Interest	Topics that users like to read/get information about, hobby, research area, expertise, work area and something that users like. The agents gain knowledge on user's interest preferences by monitoring their navigational behaviour; as referred to Habermas' theory that users' actions indicate their interest and interest is an instance of knowledge.
Knowledge network / community	This is the link of users sharing similar interest area. The community becomes groupings for people with similar knowledge interact and exchange knowledge.
Most preferred interest	Showing user's most frequent used interest keyword. The agent monitors user's used keyword and count frequency of each keyword. It will then recommend the most frequent used keyword to users as the users' most preferred keyword.
Personalization	Ability of the agent to deliver and make recommendations tailored to the user's preferences. However, users are still allowed to browse and access other information outside the personalization function as to provide a wider information access power.

CHAPTER 1

INTRODUCTION

1.1 Background

Knowledge sharing (KS) implies the giving and receiving of knowledge framed within the context by the knowledge of the source (Sharrat and Usoro, 2003). As one of the socialization and externalization process (Nonaka and Takeuchi, 2000), knowledge sharing includes interaction between people, and the exchange or transfer of the knowledge, whether in implicit or explicit form.

Explicit knowledge is more to "know-what" skills, knowledge that can be expressed in words by human agents. Implicit knowledge is more to the "know-how" skills, knowledge which can not be expressed in words, but refers to visible and demonstrable skills or a tangible culture. However, some people do not realize that what they are currently doing is part of knowledge sharing process (e.g, asking friends on their opinions on house buying tips). People also tend to either exchange knowledge only with their close friends or when they got rewards for that.

The main barriers to knowledge sharing are the lack of understanding of the benefits derived from knowledge sharing and the technology inadequacies due to the fact that knowledge is held in too many formats and repositories (Dore, 2001). Norris *et. al* (2003) asserted there has always been collaboration in company, but there is little systematic sharing of learning content, context and supporting materials.

There are many knowledge sharing model and tools created but so far the tools are concentrated to the management of knowledge as an asset and more towards management the documented knowledge, when in fact people is the most important component in knowledge sharing. According to Wiig (2005), KM role is shifting from aiming to strengthen operation by improving knowledge and its availability with information technology and communication (ICT) to building intellectual capital strategically. Researches in knowledge sharing are growing towards providing more focus on people, not to the technology (Davies *et. al* (2003); Anghern *et. al* (2001); Wiig, 2005; and Dignum (2004)).

People have always disregarded any knowledge sharing effort because they prefer to preserve their knowledge and let the knowledge becomes their precious assets. They also have lack understanding of the benefits of knowledge sharing and had limited access to other resources in the organizations. They had difficulties in accessing to the company's knowledge database and had little knowledge of where to find help in facing a problem.

All these problems hint a need for a solution that can provide an adequate assistance suited to the users need; offer personalization and intelligent assistance. Personalization and intelligent assistance could offer tailored and timely assistance to users, can react and able to anticipate to individuals' needs, and allow people to interact in an open yet secured environment. People also need a means of solution that can provide access to knowledge and resources and a secure environment for them to contribute their knowledge and get rewarded for their contributions. These requirements hint a need for a human-centred technology that would minimize user's

intervention, but still provide intelligent solutions to user's needs. Agent-based systems are the utmost qualified to model the mentioned requirements.

Agent-based system consists of several agents that play their roles to achieve the system's goal (Lee and Hwang, 2004). Agents offer a way to deal with complex systems that have multiple and distinct components, and are often used as a metaphor for autonomous, intelligent entities (Dignum, 2003a). Reactivity and proactivity of agents help to cope with the flexibility needed to deal with the dynamic nature of Knowledge Management (KM) tasks. Agent technology in knowledge sharing environment enable the environment to be viewed as a system with actors that act autonomously on behalf of the users. Each agent pursues its own goal and is used to model and implement the function of the system.

The aim of this research is to come out with an agent-based system that could provide personalization and intelligent assistance. In this case, each agent in the agent-based system to facilitate knowledge sharing (known as KSFaci for Knowledge Sharing Facilitator) is designed to provide personalization and intelligent assistance towards users. The agent provides personalization by understanding the users' interest preferences and stores them in the user profile. The second agent would then use this profile to match the users based on the users' interest similarity. The user profile that the agent built for the users is also a recommendation of the users' interests based on the agent's observation towards the user.

This research tries to combine the recommendation and similarity matching from information retrieval area to feed to the facilitation of knowledge sharing. Agent-

based system is used as an approach to model and implement the functionalities provided in this knowledge sharing facilitation framework. The main motivation in this research is towards providing intelligent assistance and personalization towards users by offering automatic interest identification of the users. This is an extension to the knowledge sharing facilitation requirement suggested by Dignum (2004) and in supporting the new generation of knowledge sharing era towards focusing the technology for people (Wiig, 2005).

This research assumes that automated interest identification can help minimize users' tasks in determining or stating their main interest manually, but rather by capturing those interests through monitoring their navigational behaviour. The interests are stored in user profile and be used to give recommendations of similar interests members of the users. The recommendations are believed to promote better knowledge sharing facilitation where users are supplied with suitable members instead of them looking for reference manually. It is also hoped to solve the problem of the current nature of inaccessible or hard-to-get knowledge resource and reference. From literature (detail in Chapter 2), no researcher has any attempt in providing automated interest identification as a way to facilitate knowledge sharing.

This research concentrates on capturing interest as part of users' knowledge as according to Habermas (1968) theory that interest is an instance of knowledge, even if the knowledge is not acted upon. He added that interest is attached to actions that both establish the conditions of possible knowledge and depend on cognitive processes. After the agent-based system is developed, an experiment is carried out to

evaluate the performance of each agent and to measure the user satisfaction towards the knowledge sharing facilitation offered by the system.

1.2 Problem Statement

Many organizations have set up Community of Practise to let people share knowledge and skills. Community of Practise is a group of individuals who are dealing with similar issues and facing similar challenges. However, the challenge is for users in finding groups and peers that can best satisfy their needs. Users also sometimes face difficulties in determining their own interest. Some of them refuse to participate in the communities because they think they are burden with extra tasks. People also feel unsecured to share knowledge due to the lack of understanding of the benefits derived from knowledge sharing and inadequacies by the provided technologies (Dore, 2001). People need a more personal means of interaction to make them comfortable exchanging knowledge and only within a controllable, trusted group (Dignum, 2004). As a response to these challenges, this study is dedicated to approach knowledge sharing facilitation with an agent-based system. The major structural problem for this scenario is to automatically identify user's interests and in recommending creation of knowledge community/networks using agent-based approach.

1.3 Research Question

The considerations above lead to the following research question:

> "How to develop and evaluate an agent-based system to facilitate knowledge sharing?"

The sub-problems for the research question are:

1. What are the requirements of agent-based knowledge sharing facilitation?
2. What are the suitable agent-based techniques to facilitate knowledge sharing?
3. How to evaluate the facilitation of knowledge sharing by the proposed agent-based system?

1.4 Research Objective

To investigate approaches to facilitate knowledge sharing with agent-based system which include providing interest identification as personalization service and knowledge network recommendation as intelligent assistance service.

1.5 Scope

This research focuses on developing agent-based system to facilitate knowledge sharing. The main aims are to provide added value through personalization and intelligent assistance to users. This research is bounded to providing a medium for capturing users' interests and then utilizes that information for knowledge network recommendation. The agent recommends members for their users based on their similar interests that the agent have captured earlier. Users can then start knowledge sharing process on their own initiative based on the member recommendation list provided by the agents. The agent can also recommend the user's interests based on the profile that has been built. The recommended knowledge network acts as a source for users to find knowledge reference that they might have not alerted to. This is according to Dignum (2004) who stressed that face-to-face communication as the