MANAGING COMPUTER LAB – MOBILE AGENT APPROACH

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MANAGING COMPUTER LAB – MOBILE AGENT APPROACH

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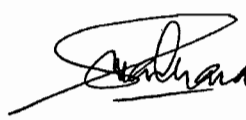
(Signature) : 

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ABSTRACT

Mobile agent is a potential method and approach in addressing many issues and problems in managing and maintaining computer labs. In educational institutions, a computer lab consists of many computers used by students and staff, and each institution has many computer labs. Maintaining these public computers is the task given to a few personnel such as computer technician. The technician has to move from one computer to another to do routine task such as running antivirus. The task is tedious and tiresome. Mobile agent has the potential and capabilities to perform the task, where mobile agent can be programmed to do task which is usually done by computer labs' technician. The mobile agent will move from one computer to another in the lab via computer network to execute the maintenance task in each computer autonomously. This work attempts to use mobile agent as a tool to manage computer labs in many aspects including reliability, security, technology and effectiveness. The results from this research show that mobile agents can be an efficient tool for managing computer labs.

ABSTRAK

Mobile Agent adalah satu kaedah dan pendekatan yang berpotensi untuk menyelesaikan banyak isu dan masalah dalam menguruskan dan menyelenggara makmal-makmal komputer. Di institusi-institusi pendidikan, makmal komputer digunakan oleh pelajar dan kakitangan di mana setiap institusi mempunyai banyak makmal komputer. Tugas-tugas penyelenggaraan komputer-komputer yang digunakan umum ini diserahkan kepada segelintir kakitangan seperti juruteknik komputer. Juruteknik komputer tersebut perlu bergerak dari satu komputer ke satu komputer yang lain untuk melakukan tugas-tugas rutin seperti menjalankan antivirus. Tugasan seperti ini adalah leceh dan memenatkan. M*obile agent* mempunyai potensi dan keupayaan untuk melakukan tugasan tersebut yang mana *mobile agent* boleh diprogramkan untuk melaksanakan tugas yang sering dilakukan oleh juruteknik makmal komputer. *Mobile agent* akan bergerak dari satu komputer ke satu komputer yang lain di dalam makmal komputer tersebut melalui rangkaian komputer untuk melaksanakan tugas penyelenggaraan di setiap komputer secara kendiri. Kertas kajian ini cuba menggunakan *mobile agent* sebagai pendekatan dalam penyelenggaraan makmal komputer di dalam banyak aspek seperti keboleh harapan, keselematan, teknologi dan keberkesanannya. Hasil kajian yang diperolehi menunjukkan *mobile agent* boleh menjadi peralatan sokongan untuk menguruskan makmal komputer.

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LIST OF ABBREVIATIONS

AOSE	Agent-Oriented Software Engineering
API	Application Programming Interface
ASDK	Aglet Software Development Kit
AUML	Agent Unified Modelling Language
DFS	Distributed File System
FIPA	Foundation for Intelligent Physical Agents
IP	Internet Protocol
JDK	Java Development Kit
JRE	Java Runtime Environment
JVM	Java Virtual Machine
LAN	Local Area Connection
MASIF	Mobile Agent System Interoperability Facility
RMI	Remote Method Invocation
RPC	Remote Procedure Call
UML	Unified Modelling Language
UniMAP	Universiti Malaysia Perlis

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CHAPTER 1

INTRODUCTION

1.1 Preface

Computer lab is a place where many computers are installed in such a way so that a class can be conducted in the lab. Instructors and students can use the computers in the lab during or after class time. Many academic departments have their own computer lab to meet their specific needs (David 2005). Because of the high number of computers in the lab, maintenance of the computers will consume a lot of time to complete. Typical maintenance jobs for a computer lab are running anti virus software, installing software updates and installs new software as needed by the class instructor. In order to do the maintenance, the technician of the computer lab has to move from one computer to another for all computers. To make it worse, in a case learning institutions, some of the institutions afford to hire only a few people to manage a large number of computers in many labs.

In modern day's computer lab, almost all computers are connected to the network. This leads to the idea to do this research. This research's idea is to make use of the interconnected computers as a medium to do computer lab maintenance. Network connections allow connected computers to be managed centrally and resources to be shared by all computers (Colin 1976). Resource sharing allows users of physically distributed computers to share data and storage by using a common file system (Eliezer and Abraham 1990). This motivated the ideas of keeping software updates in a repository. During the maintenance, the updates will be copied to the client's machine, and then the clients will run the updates. This creates a question of how to copy the

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REFERENCES

Adnan, S., Datuin, J., & Yalamanchili, P. (2000). *A Survey of Mobile Systems*. Final Project. Department of Computer Science and Engineering, University of California, San Diego.

Antonio, C., P. Gian Pietro, et al. (2007). *Is Code Still Moving Around*? Looking Back at a Decade of Code Mobility. Companion to the proceedings of the 29th International Conference on Software Engineering, IEEE Computer Society.

Bauer, B., Muller, J. P., & Odell, J. (2001) *Agent UML: A Formalism for Specifying Multiagent Software Systems*. Proceedings of the First International Workshop on Agent-Oriented Software Enginnering AOSE'00. Limerick, Ireland, LNCS 1957 Springer , pp. 91-103.

Bierman, E. & Cloete, E. (2002) *Classification of Malicious Host Threats in Mobile Agent Computing*, Proceedings of SAICSIT 2002, South Africa, ACM, pp 141 – 148

David, B. and B. Pearl (2006). *Performing systematic literature reviews in software engineering*. Proceedings of the 28th international conference on Software engineering. Shanghai, China, ACM.

David, M. C., G. H. Colin, et al. (1997). *Mobile Agents: Are They a Good Idea*? Selected Presentations and Invited Papers Second International Workshop on Mobile Object Systems - Towards the Programmable Internet, Springer-Verlag.

Elizabeth, A. K., P. V. M. Krishna, et al. (2000). An application framework for intelligent and mobile agents, ACM. **32:** 20.

Fran and R. ois (1996). A Web navigator with applets in Caml, Elsevier Science Publishers B. V. **28:** 1365-1371.

Ince, D. (2001). Mobile Agent, A Dictionary of the Internet. Ofxord University Press.

Johansen, d., Renesse, R. V., & Schneider, F. B. (1994). *Operating Computer Support for Mobile Agents*. Department of Computer Science, Cornell University.

Katsuno, Y., Murata, K., & Tokoro, M. (1997). *A Java Front-End Approach for Programming Mobile Agents*. Tokyo, Sony Computer Science Laboratory Inc.

Kang, M., Wang, L., Taguchi, K. (2005). *Modelling Mobile Agent Applications in UML2.0 Activity Diagrams*. University of Bradford.

Kotz, D., Gray, R., & Rus, D. (2002). *Mobile Agents. Future Directions for Mobile Agent Research*. Dartmouth College.

Lange, D. B., & Oshima, M. (1998). *Programming and Deploying Java Mobile Agents with Aglets.* Reading MA: Addison- Wesley.

Rama, J., Bishop, J. (2005) *Towards a mobile agent framework for Nomad using .NET.* Proceedings of SAICSIT 2004, pp 111 –113

Ravi, J., A. Farooq, et al. (2000). *A Comparison of Mobile Agent and Client-Server Paradigms for Information Retrieval Tasks in Virtual Enterprises*. Proceedings of the Academia/Industry Working Conference on Research Challenges, IEEE Computer Society.

Robert, S. G. (1995). *Agent Tcl: A Transportable Agent System.* Proceedings of the CIKM Workshop on Intelligent Information Agent, 1995, Fourth International Conference on Information and Knowledge Management, Baltimore, Maryland.

Srikanth, B., Kirubakaran, D., Siddharth, N., Sanyal, S. (2007). *Software Installation on a Huge Heterogeneous Network using Mobile Agents*. International Conference on Computer and Information Science (ICIS 2007). IEEE Computer Society.

Tommy, T. (1997). *Programming languages for mobile code*, ACM. **29:** 213-239.

Knabe, F. (1996). An overview of mobile agent programming. In Proceedings of the Fifth LOMAPS workshop on Analysis and Verification of Multiple - Agent Languages, number 1192 in LNCS, Springer-Verlag.

Zahia, G., F. Nora, et al. (2005). Adaptive replication of large-scale multi-agent systems: towards a fault-tolerant multi-agent platform, ACM. **30:** 1-6.

Maxim, P., A. Donovan, et al. (2004). Network Awareness for Mobile Agents on Ad Hoc Networks. Proceedings of the Third International Joint Conference on Autonomous Agents and Multiagent Systems - Volume 1. New York, New York, IEEE Computer Society.

Stefan, P. (2007). Specifying protocols for multi-agent systems interaction, ACM. **2:** 15.

Johnny, W., H. Guy, et al. (2001). SMART mobile agent facility, Elsevier Science Inc. **56:** 9-22.

Marthie, S., Elsab, et al. (2003). Architectural components for the efficient design of mobile agent systems. Proceedings of the 2003 annual research conference of the South African institute of computer scientists and information technologists on Enablement through technology, South African Institute for Computer Scientists and Information Technologists.

Thomas, R. G. (1993). A translation approach to portable ontology specifications, Academic Press Ltd. **5:** 199-220.

Velde, W. V. d. and J. W. Perram (1996). Agents breaking away
7th European Workshop on Modelling Autonomous Agents in a Multi-Agent World, MAAMAW '96, Eindhoven, Netherlands, January 22-25, 1996 : proceedings. Berlin ; New York, Springer.

Almeida, A. L., S. Aknine, et al. (2006). Plan-based replication for fault-tolerant multi-agent systems. Parallel and Distributed Processing Symposium, 2006. IPDPS 2006. 20th International.

Athie, L. S. and A. D. Scott (2003). Designing and specifying mobility within the multiagent systems engineering methodology. Proceedings of the 2003 ACM symposium on Applied computing. Melbourne, Florida, ACM.

Benno, O., B. Frances, et al. (2003). Fault Tolerance in Scalable Agent Support Systems: Integrating DARX in the AgentScape Framework. Proceedings of the 3st International Symposium on Cluster Computing and the Grid, IEEE Computer Society.

Chih-Chieh, Y., C. Chung-Kai, et al. (2006). Streaming support for Java RMI in distributed environments. Proceedings of the 4th international symposium on Principles and practice of programming in Java. Mannheim, Germany, ACM.

Chiossi, C. (2004). "Aglets." Retrieved 2 October 2008, 2008.

Chris, P. (2001). Agent mediated electronic commerce research at Hewlett Packard Labs, Bristol, ACM. **2:** 18-28.

Colin, W.-S. (1976). Current research in computer networks: a personal view, ACM. **6:** 13-40.

David, J. B. (2005). Looking outwards: extending services to departmental labs. Proceedings of the 33rd annual ACM SIGUCCS conference on User services. Monterey, CA, USA, ACM.

David, K. W. and K. W. James (2001). Towards the distributed processing of mobile software agents, ACM. **9:** 2-5.

David, W., P. Noemi, et al. (1999). Java-based mobile agents, ACM. **42:** 92-ff.

Deja, M. (1999). Mobile Agent Applications, IEEE Educational Activities Department. **7:** 80-90.

Eliezer, L. and S. Abraham (1990). Distributed file systems: concepts and examples, ACM. **22:** 321-374.

Feng, L. and B. Kris (2004). A RMI protocol for Aglets. Proceedings of the 27th Australasian conference on Computer science - Volume 26. Dunedin, New Zealand, Australian Computer Society, Inc.

Gray, R., D. Kotz, et al. (1997). Mobile agents: the next generation in distributed computing. Parallel Algorithms/Architecture Synthesis, 1997. Proceedings. Second Aizu International Symposium.

Gray, R. S., G. Cybenko, et al. (2002). D'agents: applications and performance of a mobile-agent system. **32**.

Hideki, T. and K. Kazuya (1999). The Aglets project, ACM. **42:** 100-101.

Jason Maasen, R. V. N., Ronald Veldema,Henri Bal, Thilo Kielmann, Ceriel Jacobs, and Rutger Hofman (2001). Efficient Java RMI for parallel programming, ACM. **23:** 747-775.

Kagal, L., T. Finin, et al. (2001). A Delegation Based Model for Distributed Trust. Workshop on Autonomy, Delegation, and Control: Interacting with Autonomous Agents, International Joint Conferences on Artificial Intelligence.

Manoel, M., C. Daniela, et al. (2006). Using observational pilot studies to test and improve lab packages. Proceedings of the 2006 ACM/IEEE international symposium on Empirical software engineering. Rio de Janeiro, Brazil, ACM.

Marques, P., P. Simoes, et al. (2001). Providing applications with mobile agent technology. Open Architectures and Network Programming Proceedings, 2001 IEEE.

Marthie, S., Elsab, et al. (2003). Architectural components for the efficient design of mobile agent systems. Proceedings of the 2003 annual research conference of the South African institute of computer scientists and information technologists on Enablement through technology, South African Institute for Computer Scientists and Information Technologists.

Nejla, A.-H. (2005). A framework for building adaptive mobile agents. Proceedings of the fourth international joint conference on Autonomous agents and multiagent systems. The Netherlands, ACM.

Nils, P. S. and J. Dag (2002). Software Deployment Using Mobile Agents. Proceedings of the IFIP/ACM Working Conference on Component Deployment, Springer-Verlag.

Olga, R., C. Dipanjan, et al. (2004). Service discovery in agent-based pervasive computing environments, Kluwer Academic Publishers. **9:** 679-692.

Sanjeev, K. and R. C. Philip (2000). Towards a fault-tolerant multi-agent system architecture. Proceedings of the fourth international conference on Autonomous agents. Barcelona, Spain, ACM.

Thomas, J., P. Adrian, et al. (2002). ROADMAP: extending the gaia methodology for complex open systems. Proceedings of the first international joint conference on Autonomous agents and multiagent systems: part 1. Bologna, Italy, ACM.

Tobias, B. (2002). Technologies for the development of agent-based distributed applications, ACM. **8:** 8-15.