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Design and Implementation of a Distributed Agent-Based Client Process Monitoring System

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Abstract: The purpose of this study is to create a distributed Agent-Based Client Process Monitoring System which is characterized by the ability to monitor all running processes of the client agent which can be installed in a distributed environment and can inform the results of monitoring processes via hypertext transfer protocol (http) to a server. The network administrator can keep watch over all running processes and effectively control the processes by using the report from the Client Process Monitoring System. Users can autonomously run processes on their system while the administrator may monitor client computer process usage. Therefore, the network administrator can monitor users' running processes based on a monitoring report in a public, distributed computing environment and then advise computer users to refrain from running unnecessary processes based on this report.

Key words: Distributed agent, Process Monitoring System, server, network, public, Korea

INTRODUCTION

The number of Internet users has increased explosively around the world in terms of the rapid spread of new information technology, various computing environments and widespread and effective services in computing and networking.

With the level of technological change occurring now, it is necessary to effectively manage computing environments in order to provide Internet space for straightforward and comfortable use as well as to utilize online teaching and learning systems (Ryu and Lee, 2007). In addition, there are social issues to be considered, such as taking identification information from public computers, spreading viruses and malware to others over the internet, security and so forth.

There are two typical approaches to administering many systems in public environments: Monitoring screens of remote computers and limiting use by the network administrator and gathering information about the web-based network traffic and restraining this traffic. However, these approaches require continuous real-time monitoring of the network environment (Kwon *et al*., 2008; Chan, 2001). Thus, it is difficult to perform a real-time and user-centered management approach to monitoring network traffic. In addition, there are additional weaknesses to the typical approach to monitoring the network environment when the administer analyzes and interprets running processes: difficulty in reviewing the detail of running processes and insufficient reporting functions regarding the results of monitoring these running processes.

Therefore, in the present study, researchers designed and implemented an administration system that can resolve the above limitations of monitoring systems and monitor the processes and their status in the client via the Distributed Agent-Based Client Process Monitoring System.

In the system, administrators can monitor unnecessary processes that are being run by other users or intruders in the public system environment (Kim *et al*., 2006; Cho *et al*., 2005).

Related works: Chung (2004) designed and developed a system for efficient instruction and for effective PC administration in a computing room.

This system provides the functions to understand students' classroom attitudes by monitoring students' screens, the ability to actively cope with situations, the ability to control students' computers (individually or on all computers).

Lee (2004) implemented a web-based traffic monitoring system for a small computing room. The system proposed by Soon (2004) provides guidelines for system administrators to check the network and internet with an administrator's minimum knowledge regarding system administration. Also, it provides familiar PC environments and interfaces for the system administrator

in order to minimize the specific behaviors required to administer the system. Lee (2004) designed and implemented an internet access information management system to analyze adolescents' internet access which is used to trace website visits and analyze trends, to gather information regarding the websites visited by adolescents, to categorize this information and to understand the characteristics of website use in adolescents. Parents and teachers can guide their adolescents by promoting safe and healthy internet use with little expense or additional system improvements.

Choi (2005) proposed a monitoring system for system administrators that can optimize the availability of learning services through monitoring these learning services and managing system faults. The proposed system is based on the master-agent architecture, providing a warning service regarding the monitored results and an automatic recovery service when it detects problems.

Yi and Lee (2007) have developed a program to be able to increase efficiency of web-based instruction and to be able to direct the instruction in the teacher's intended direction in terms of detecting and blocking websites accessed by students that are not directly related to the instruction. The program makes it possible to be applied to the small size network environments in K-12 schools, creating classroom management at the level of students, teachers and schools and facilitating effective management of computing rooms in the school.

MATERIALS AND METHODS

System design: Figure 1 shows the system used to monitor the client processes in the networked environment.

First, the agent used to monitor each system's processes is installed in each client system across many personal computers. The installed agent starts automatically when the operating system is rebooted. The agent also provides system options.

Second, the middleware server extracts a unique identification from each agent when the user starts the computer and the server then runs a UID generator and a PID generator creating the identification of executed processes. Utilizing these steps, the server sends the monitoring data to the database and reporting server.

Third, the database and reporting server stores the monitoring data from the middleware server and generates reports after summarizing the data.

After logging in the database and reporting server, the monitoring administrator may then request that reports be generated by using a web browser. The database and reporting server transmits the monitoring results using a preset format.

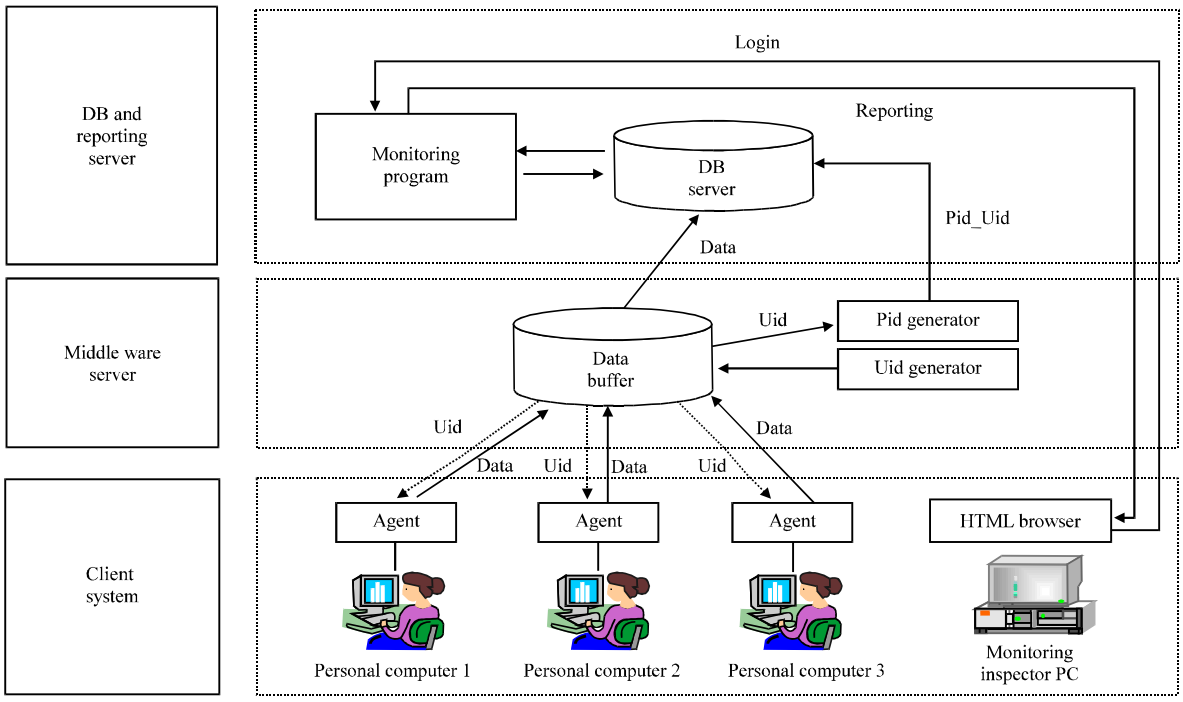

Fig. 1: System design

RESULTS AND DISCUSSION

Distributed agent program: The distributed agent program installed on the client needs to be free to be operated in various user environments. The agent program in the present study can run on easily acceptable minimum hardware and software requirements (Table 1).

The program interface of the distributed agent program consists of a results display area, buttons for uploading and saving, process filtering options and buttons when a program is running. Figure 2 shows the screen capture of the distributed agent program.

The distributed agent program is initially set to be invisible on the user's screen as the default. However, the program can be controlled by the options menu, chosen in the screen menus according to the user and computer administrator's needs. This program can monitor all processes in the client system and extract processes that are visible to the user via the filtering options. The names of the extracted processes can be sent to the client screen or server after being converted into understandable forms.

Figure 3 shows the workflow after loading the agent program in the client system. First, the program runs the process monitoring. The program continuously monitors the client system's processes and sends data to the server if that is possible (if sending data to the server is not possible, the client holds the monitoring data in the system and keeps monitoring the processes).

Table 1: Minimum system requirements for the distributed agent program

System requirements	Values
HW	
CPU	Over Intel 1.6 Ghz
Disk storage	Over 1 GB
Network	10/100 Mbps
SW	
OS	MS Windows XP

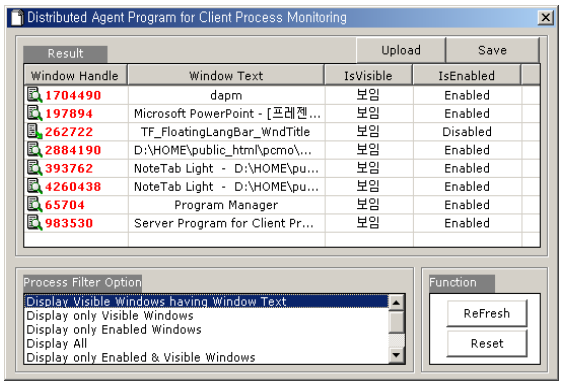

Fig. 2: The screen capture of the distributed agent program

Server program: The program installed on the server plays the role of saving and manipulating data sent from the agent installed on the client and then reporting relevant information to the administrator. It is helpful for the server to support various web browsers. The server program in the present study can research in the environment shown in Table 2.

The server presents the following: serial number of information, record time, unique identification related to the agent, the location where the agent is installed, a list of processes and a confirmation button for details. Figure 4 shows the access screen of the server showing the above attributes.

The server program can be accessed by a smart phone to increase the user's ease of using the program. It is possible that the smart phone can be applied to utilize the information of the client process monitoring similarly to using a PC browser. Figure 5 shows the screen accessed via smart phone. Table 3 shows the major attributes of the database schema in the server program.

Table 2: Minimum system requirements of the server program

System requirements	Values
HW	
CPU	Over Intel 1.6 Ghz
Disk	Over 1 GB
Network	10/100 Mbps
SW	
OS	MS Windows 2003 Server
Web Browser	Internet Explorer and Opera, Fire Fox

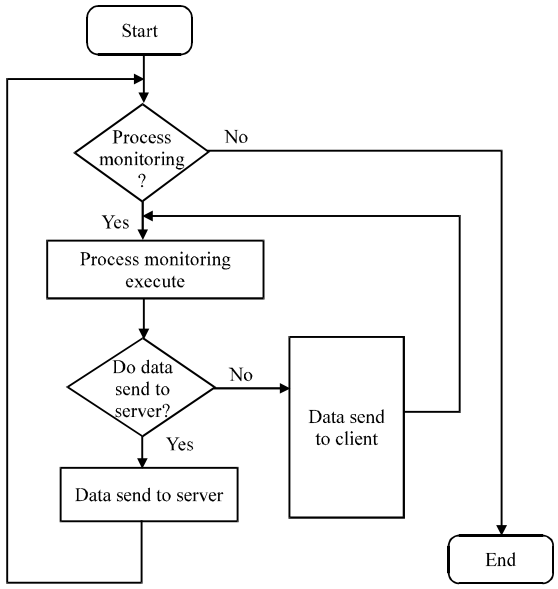

Fig. 3: The workflow of the agent program in the client system

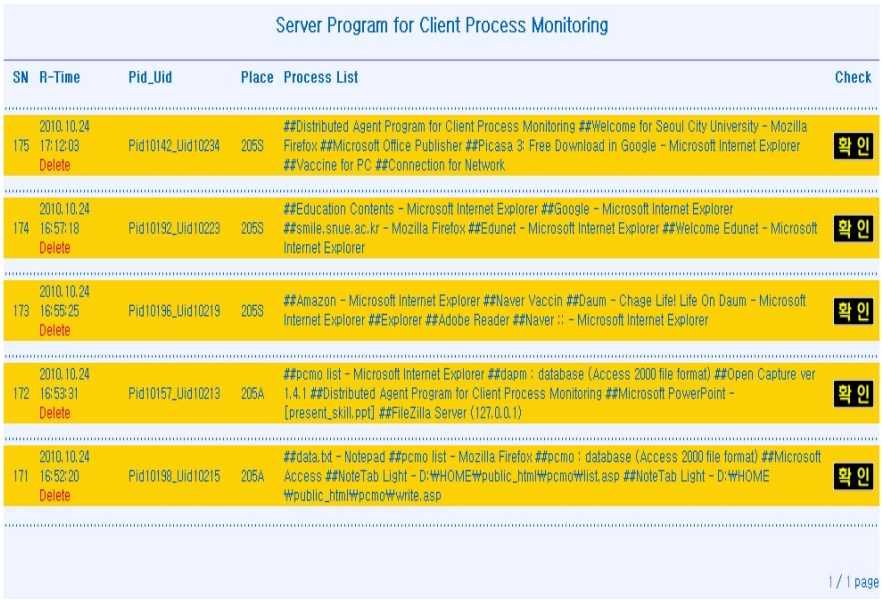

Fig. 4: The screen of the server program for client process monitoring

Fig. 5: Server screen accessed via a smart phone

Table 3: A list of database schema table

Attribute	Description
SN	Serial nmber of entity
R_Time	Recording time of entity
Pid_Uid	Unique identification of agent data
Place	Location information of agent
P_List	Client's process list data
Check	Confirmation

CONCLUSION

There are three methods used to manage multiple systems and to monitor client processes on public systems: in terms of monitoring the user's screen, the administrator can figure out the patterns of users and actively alter these patterns, in terms of monitoring web-based traffic, the administrator can check and monitor networks and the Internet and in terms of using automatic document classification to analyze user visits and movement on the internet, the administrator can extract web documents from the classification.

However, these methods have several disadvantages such as the need for monitoring by the system administrator in real time and being unable to conduct follow-ups when users execute unnecessary processes.

To resolve these limitations, we decided to adopt agent-based reporting in order to monitor client processes. Therefore, the administrator using the system can asynchronously monitor and review the contents of the executed process of the client with ease. In addition, this system can guide users to avoid executing unnecessary processes. Future studies need to optimize this software to install the distributed agent and to advance performance.

Second, the software needs to have the multi-protocol-based monitoring function to enhance the performance efficiency of the distributed agent and server module.

Third, development of the report authoring tool should be considered to increase the ease of use by the administrator and the increased satisfaction of reporting.

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