DEVELOPING A COMPUTER SERVER SYSTEM WITH VIRTUAL COMPUTER TECHNOLOGY

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ABSTRACT

In this study, a computer server system with virtual computer technology was installed and tested, to determine whether the system, transferred from an original working server, was service-ready. Once the initial testing was completed, the system was put into service, where the author followed up, monitored, and examined the working of the system, which was then installed on a virtual server. Usage and performance matrix were monitored, including CPU, RAM, and hard disk utilization. To ensure that the virtual computer could handle all required tasks correctly and effectively, its notification system was also tested. The system sent out notifications where issues arose, prompting the administrator to take actions, such as adjusting the virtual computer's system parameters to suit the system requirements.

318 samples consisting of personnel from The Office of General Education and Innovative Electronic Learning tested the virtual computer system, and completed a survey regarding their level of satisfaction in the effectiveness of the system. Results indicated that, overall, the users were *very satisfied* with the effectiveness of the system ($\bar{x} = 4.45$, s.d. = 0.15).

Keywords: System development, Server computer, Virtual computer

INTRODUCTION

Networking technology has been developing at a rapid pace, and has been adopted for various applications. At The Office of General Education and Innovative Electronic Learning, Suan Sunandha Rajabhat University, Thailand, we have revised our current networking technology, to solve existing problems and increase performance, both in terms of cost-effectiveness and outputs.

The Office of General Education and Innovative Electronic Learning is responsible for organizing general education courses for undergraduate students of Suan Sunandha Rajabhat University, totaling more than 20,000 students. The Office has employed virtual computer technology to fulfil the need for a large number of server computers required for developing and organizing online teaching, examinations, grading, and other educational services for all general education courses. The technology facilitates the process of synchronizing different servers to the web site that allows students to register for their courses in each academic semester, and that provides various other educational services, improving the effectiveness of the overall system.

The author has experiences in general and corrective maintenance of the servers and other working systems of The Office of General Education and Innovative Electronic Learning, and is responsible for ensuring that the systems are up to standard and are 24-h-per-day service-ready.

The Office of General Education and Innovative Electronic Learning is currently facing issues resulting from a large number of students registering for the general education courses, from restructuring of many of the courses, and from consequences of the Covid-19 pandemic. In response, the author and other related offices have collaborated to find a computer resource management solution that maximizes the service capacity and prevents potential issues that a surge in usage could cause.

It can be observed that, overall, both public and private organizations have started to be aware of and adopt the virtual computer technology – a technology which allows computer systems to be emulated as virtual systems. Different virtual systems can run separate operating systems and applications, and operate on different platforms, independently, on the same physical machine. This technology allows hardware for computing, storing data, and communication to be organized in clusters and used adaptively according to the need at a given time. This reduces the upgrade-associated costs and maintenance costs of the information technology system, which are usually very high, due to the difficulties of maintaining such a system – a process which usually relies on a highly specialized service provider. Compared to the old system, where each physical server operated only one web service, the use of virtual computers offers a cost-effective solution, suitable for the current environment. It reduces both cost and the required number of service personnel, while maintains a high level of system effectiveness.

In regard to the present state of virtual computer technology, there is a high degree of competition between different commercial systems, such as VMware, Microsoft Hyper-V, and Sangfor HCI (hyper-converged infrastructure). The increased competition is a good trend which can lead to reduced prices, and which encourages the adoption of this technology in medium- and small businesses. Of these available systems, we use Sangfor HCI from Sangfor Technologies, Shenzhen, China. This platform has an advantage of being a HCI platform, and thus, can integrate computing applications, storage, networking solutions, and continuous data protection (CDP) in one software-defined console. Its support for this unified management approach makes the operation easy to learn. A new operator can learn all system functions in 1 day. Moreover, this system could reduce the overall cost by more than 60 per cent compared to other alternative systems, while increase the effectiveness of the application. The system

also supports scheduled incremental backup without requiring an additional license, and is flexible in terms of supported hardware. It can operate on both x86 and x64 architectures, allowing its deployment on legacy hardware systems.

MATERIALS AND METHOD

2.1 Study Approach

The virtual computer system of The Office of General Education and Innovative Electronic Learning consists of 2 components, namely the hardware, where good performance hardware is available; and software, where Sangfor HCI is to be operated as a control unit, communicating with the virtual machine software, which emulates physical resources, such as the processor, physical memory, network connections, and IO devices.

Sangfor is the number one next-generation firewall (NGFW) provider from China. The HCI emphasizes on security and NGFW integration, on top of the conventional computing storage and network components, to fulfil the growing demand for converged infrastructure. Sangfor is the number one enterprise-class NGFW provider. Their HCI platform supports computing, storage, and network virtualization, and optimizes their integration on one set of hardware, to maximize performance. It essentially creates a small data center that can be used in different applications. It also supports network functions virtualization (NFV), namely Sangfor's NGFW, providing a very high degree of security at a reasonable price.

Moodle is a learning management system (LMS) and a course management system (CMS) platform – i.e., a platform for virtual, online classes – deployable via both the internet or an intranet network, designed for educational institutions or teachers. It can be used for preparing and distributing course materials and activities via a network. Moodle can be deployed on an institution level, in universities, school, institutes, or by private tutors. This software is open-source under gnu.org's General Public License.

MySQL is a database management software developed by MySQL AB, able to systematically store information, process SQL commands, and that must be used in conjunction with another software or service, such as a web server that processes server-side scripts – such as PHP, ASP.net, or GSP – or an application programming language – such as Visual Basic, Java, or C# – to create a system that fulfil users' requirements. MySQL can be run on various operating systems, and is the most widely used open source database system.

PHP is an open source, server-side scripting language used by web sites to create HTML scripts used for their displays. It has a basis based on the C, Java, and Pearl scripts. PHP is a relatively easy-to-learn script, having the main goal of enabling web developers to create responsive web pages.

Java is an object-oriented programming language developed by James Gosling and his fellow engineers at Sun Microsystems, Inc. It was developed in 1991 as a part of the Green Project, and was completed and distributed in 1995. The main goal was for it to be a C++ alternative, with a syntax similar to that of Objective-C. Originally, it was called Oak, named after the oak tree near Gosling's office. However, due to licensing issues, it was renamed to Java – a coffee name – instead.

Microsoft Windows is an operating system developed by Microsoft Corporation, debuted in 1985. The first version was named Windows 1.0, which was popularized and took over 90 per cent share of the market for operating systems for personal computers worldwide. The current version of Windows is Windows 10.

2.2 Research Design

The development of a virtual computer technology in The Office of General Education and Innovative Electronic Learning is a new developmental research project that studies, analyzes, designs, and develops the virtual computer technology. The goal is to manage the Office's servers, synchronizing them with the web site used by students to register for their courses in each semester; and to allow the Office to monitor the web site usage, in order to effectively provide services to the students and to the members of staff of the University throughout the academic semesters.

2.3 Method

In developing the virtual computer technology, the author divided the method into 7 parts according to the principle of Systems Development Life Cycle (SDLC), described by Iamsiriwong (2003: 62), as follows.

1. Problem Recognition
2. Feasibility Study
3. Analysis
4. Design
5. Development
6. Implementation and Testing
7. Maintenance
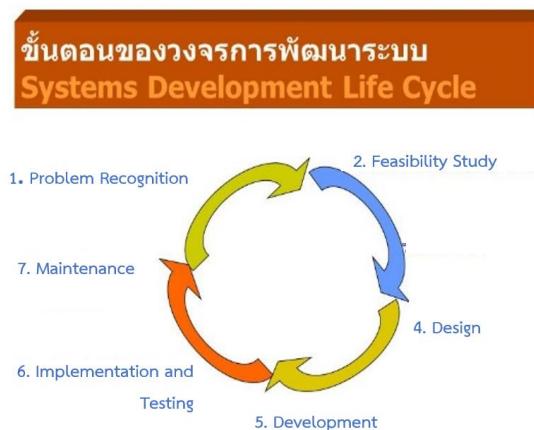
Figure 1 Components of the Systems Development Life Cycle

2.4 Population and Sample

1. The population of this study consisted of the students of Suan Sunandha Rajabhat University

2. The sample of this study consisted of 318 students of Suan Sunandha Rajabhat University, selected using purposive sampling

2.5 Materials

In collecting data, the author aimed to acquire a complete set of data and encourage related persons to participate in the survey, in order for the virtual computer system to be developed into a sustainable system. The details were as follows:

1. Review of related documents

2. Conduct in-depth interviews with persons related to the information regarding the process of registration of additional courses

3. Distribute questionnaires, which were designed in a collaboration with 3 experts, on the registry system of the Suan Sunandha Rajabhat University, on analysis and designs of information systems, and on management of the registry data, respectively. The author has refined and improved the questionnaires in accordance with the experts' suggestions.

2.6 Data Processing

After the answers to the questionnaires were collected, statistical analysis was performed to determine the level of satisfaction in the effectiveness of the virtual computer system developed by The Office of General Education and Innovative Electronic Learning. Arithmetic means and standard deviations were computed.

2.7 System Evaluation

Questionnaires, distributed after the implementation of the virtual computer system, were used to evaluate the performance of the system, and to provide a basis for its future improvements.

2.8 Research Location

The research location was the Computer Lab room 3111 of The Office of General Education and Innovative Electronic Learning, Suan Sunandha Rajabhat University.

RESULTS AND DISCUSSION

3.1 Implementation Results

Working of the implemented virtual computer system is shown in Figure 2-5.
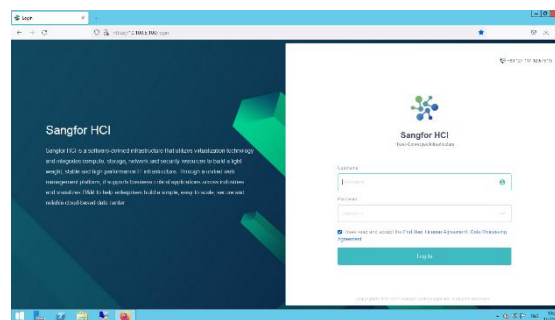
Figure 2 The home page of the virtual computer system of The Office of General Education and Innovative Electronic Learning
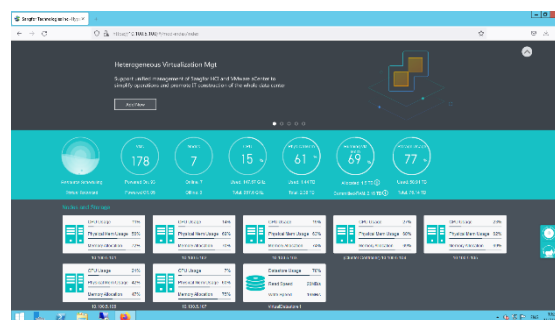

Figure 3 The page displaying usage statistics of the virtual computer system

Figure 4 The page showing performance of different virtual machines
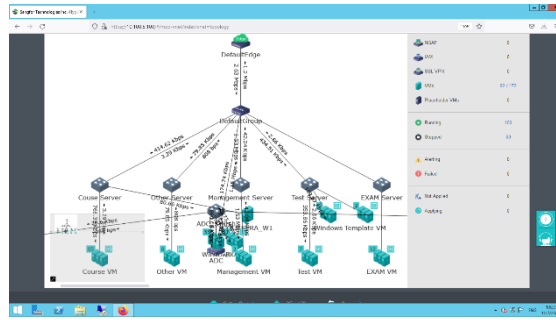
Figure 5 The page showing different components in the virtual computer system

3.2 Evaluation Results

Results from the assessment of user satisfaction in the effectiveness of the Developing a computer server system with virtual computer technology of The Office of General Education and Innovative Electronic Learning were as follows.

Table 1 User satisfaction in the effectiveness of The Developing a computer server system with virtual computer technology of The Office of General Education and Innovative Electronic Learning

Item number	Aspect of system effectiveness	User satisfaction in the system's effectiveness		
		Mean value $(\bar{x})$	Standard deviation	Satisfaction level
1)	The program functions suited the needs of the user	4.35	0.43	high
2)	The program could perform intended procedures	4.59	0.47	high
3)	The program was easy to use	4.42	0.44	high
4)	The program met the expectation of the user	4.30	0.35	high
5)	The program provided data security	4.30	0.41	high
	Overall satisfaction in the system's effectiveness	4.33	0.15	high

Shown in Table 1, test users expressed an overall satisfaction score of 4.33, with a standard deviation of 0.15, implying that the overall satisfaction level was high.

CONCLUSION

After the development of the virtual computer system by The Office of General Education and Innovative Electronic Learning, answers to the questionnaires on user satisfaction in the effectiveness of the system were collected and processed. The processed data could be summarized as follows:

1. The aspects that yielded the highest satisfaction score were the ease-of-use and data security, having an equal score of $\bar{x} = 4.35$, implying a high satisfaction level.

2. The aspects that yielded the lowest score was whether the functions suited the needs of the users, having an average score of $\bar{x} = 4.59$, which still implied a high level of user satisfaction. For the aspect of whether the program could perform intended procedures, the average score was $\bar{x} = 4.42$. In the aspect of whether the program met the expectation of the users, the average score was $\bar{x} = 4.30$. The scores for the latter two aspects, as with the other aspects', implied a high level of user satisfaction.

Overall, a satisfaction level of $\bar{x}$ = 4.45 was achieved, implying that the virtual computer system of The Office of General Education and Innovative Electronic Learning could function correctly, fulfil the needs of the Office, and provide an easy-to-use solution for assessing relevant records.

DISCUSSION

The results of the study on the development of the virtual computer system of The Office of General Education and Innovative Electronic Learning revealed several interesting aspects, discussed below:
1. A good system design consisted of an engaging and easy-to-use user interface.
2. From the initial test and the evaluation, the user satisfaction was at a high level, in line with the objective of this study
3. There should be a development of the system into a mobile application, to create a higher degree of ease-of-use. More functions, such as statistical reports, could also be added.

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