Virtualization Technology for Multimedia Interaction Cloud Education Services

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Abstract

For enhancing the effectiveness of teaching and learning, e-learning is one of ways to achieve the goal. In past e-learning platforms, when more and more teaching materials are provided from characters (teachers, students, independent software vendors (ISV) and content service vendors (CSV)), or more and more the characters use the platforms, the performances of the platforms are reduced obviously. Moreover, teaching resources cannot be shared widely via the platforms. In this paper, we have implemented an Innovative Green Cloud-based education software Services system (IGCS) and have tested the performance of the IGCS. Readers can refer to our paper to improve the performance of their cloud-based education platforms.

Keywords: Cloud Computing, E-learning, Virtualization Technology, Multi-media.

1. Introduction

All papers must be sent in Word and PDF format. For enhancing the effectiveness of teaching and learning, e-learning is one of ways to achieve the goal [1][2][5]. With the help of e-learning platforms, various learning resources provided by ISVs and CSVs could be applied and accessed online without the restriction of time and location. Obviously, many e-learning platforms were proposed in the past [2][6] due to the evolution of the advanced ICT technology. However, most of the platforms are designed stand-alone and client/server-based. It implies that as the numbers of the users increase, the system's performance is inclined to diminish owing to the bandwidth of the network. Furthermore, if the module functions are not flexible implemented and the repository behind the application users is not well-structure, teaching and learning resources cannot be easily accessed and shared.

Recently, the cloud computing is gradually adopted to be an excellent solution in different fields. Many companies have migrated their services to the cloud. Unfortunately, education platforms do not profit from the cloud computing and the development of educations platforms will be limited.

In this paper, we have implemented the IGCS, which is Taiwan’s first cloud-based education platform and has been widely adopted by elementary, secondary and junior high schools in Taiwan. We also have designed three scenarios to launch the testing for proving that thousands of people can use the IGCS at the same time. Finally, readers can refer to our paper to improve the performance of their cloud-based education platforms.

2. IGCS

The IGCS is a cloud-based educational platform to facilitate the interactions between teachers and students in and after classes. The IGCS includes several functionalities that are implemented as modules for educators to perform their instructions separately. For each module, the IGCS provides a public cloud repository that contains a lot of multimedia resources such as images, videos and flash maintained by the publisher. Besides, each user registered to the IGCS would gain personal repository to preserve their creations. Hence, teachers could create teaching contents by themselves or reuse other resources obtained from the cloud or others. Once the IGCS is deployed to schools, various modules are settled tailored to the following five characters:

- Teacher: As shown in Figure 1, all modules include the plan, exercise, assessment and homework consist of authoring tools utilized to create, edit and share their teaching profiles on the cloud. Teachers are freely to conduct one of them, or to organize an associative and successive instructional scenario in the "Package" module for students to engage in.
- Student: As shown in Fig. 2, students are allowed to participate in learning tasks which are assigned by their teachers in the corresponding modules as teachers' sides.
- Educational administrator: As shown in Fig. 3, the educational administrator is responsible for managing the account information of the teachers, students and classes.
- System integrator: As shown in Fig. 4, ISVs and CSVs are authorized to upload various kinds of teaching and learning materials to the repository of the IGCS.
- System administrator: As shown in Fig. 5, the system administrator is authorized to control all the other role's permissions and adjust global settings in the IGCS.

3. Experiments in the IGCS

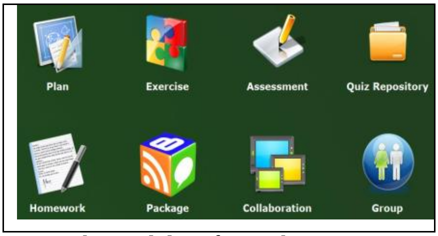

Fig. 1: The modules of "Teacher".

Fig. 2: The modules of "Student".

Fig. 3: The modules of "Educational administrator".

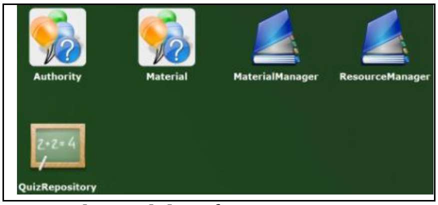

Fig. 4: The modules of "System integrator".

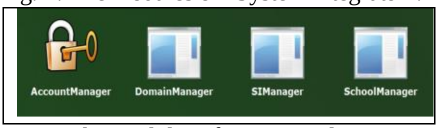

Fig. 5: The modules of "System administrator".

We deploy our IGCS on a cloud platform called CAKE [8](Cloud Appliance Kernel Environment), where the CAKE is developed by Cloud System Software Institute of Institute for Information Industry. The initial size of virtual machines (VM) is 6. The developer of the IGCS can employ the management console to manipulate the resource and monitor the status and security of the VMs. The architecture is shown in Fig. 6.

- Administrator: system administrator can employ Remote Desktop or

SSH to login to the management console for manipulating the resource utilities of the VMs. When the resources are insufficient or are excess, the administrator can scale out/in the resources.

- Characters: all the participants send their requests to the system via HTTP protocol.

The roles of the VMs are:

- "App": forward the requests.
- "File": store the all teaching and learning materials.
- We use mysql as our database and employ the "Sync" technique of the mysql to replicate the data in the database. When the characters want to create class information and user accounts and send the exam and homework answers, the requests are sent to "WriteDB". When the characters want to read the class or exam information, login the system, and maintain personal information, the requests are sent to "ReadDB". When the requests are sent to "WriteDB", the "WriteDB" sends the updated contents to "Backup" for backup copy.

3.1. Software/Hardware

All the configurations of the VMs are: (1) OS: Windows Server 2008 R2 Standard Service Pack 1 / 64-bit; (2) CPU: Intel Core 2 Xeon 3.33GHz; (3) RAM: 4 GB.

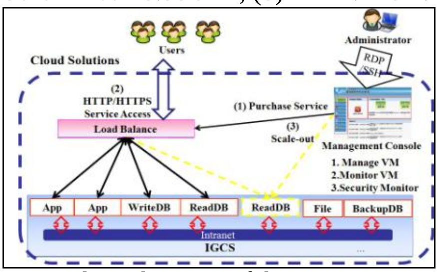

Fig. 6: The architecture of the IGCS

- Network bandwidth: 1Gbps
- Web server: Apache Tomcat 6.0 and connection pool is 100
- Database: Mysql 5.0 and connection pool is 10000.

3.2. Test Program and Monitor Tool

We use Apache JUnit as our test framework to run the performance tests. We also use Perfmon to monitor the performance in the server: (1) Apache JUnit 4: Java; (2) Perfmon: the tool is stored in Windows Server 2008 R2.

4. Experiment Results in the IGCS

The goal of testing is to know the system performance of the IGCS. The test results are used to understand that when the characters join/leave the IGCS momentarily, the resources of the IGCS should be scaled out or in.

4.1. Scenario 1: User Authentication

We simulate many characters which want to log into the system at the same time for obtaining desired services. Note that A→B:M denotes A sends a message M to B.

- Characters→"App": login requests.
- "App"→"ReadDB": login requests.
- "ReadDB"→"App": the result of the verifications.
- "App"→Characters: the result of the verifications.

We define that an acceptable criterion is 5 second. The result is shown as follows:

- In 6VMs: the processed requests are 900. The resource needs are: "App":CPU20%,Network<15%, Disk 14 reads/writes and memory 48%. "ReadDB": CPU9%, Network <15%, Disk 2 reads/writes and memory 24%. The maximum, minimum and average of the response time are 3.746s, 0.032s, and 2.304s.
- In 12VMs: the processed requests are 2000. The resource need are: "App": CPU9%, Network<15%, Disk 5 reads/writes, and memory 45%. "ReadDB":CPU12%, Net-

work<15%, Disk 3 reads/writes and memory 25%. The maximum, minimum and average of the response time are 4.979s, 0.016s, and 1.405s.

- In 24VMs: the processed requests are 4000. The resource needs are: "App": CPU 7%, Network <15%, Disk 3 reads/writes and memory 44%. "ReadDB":CPU12%, Network<15%, Disk 3 reads/writes and memory 24%. The maximum, minimum and average of the response time are 4.183s, 0.031s, and 1.012s. We show the results in Fig. 7.

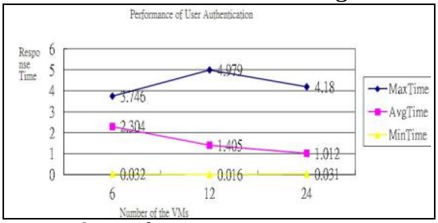

Fig. 7: The performance in Scenario 1.

4.2. Scenario 2: Download of the Examination

We simulate many characters which want to download the examination at the same time. We use multiple-choice examination as our sample.

- Characters → "App": download requests of the examination.
- "App" → "File": download requests of the examination.
- "File" → "App": the examinations.
- "App"→Characters: the examinations.

We define that an acceptable criterion is 5 second. The result is shown as follows:

- In 6VMs: the processed requests are 1500. The resources needs are: "App": CPU 8%, Network <15%, Disk 2 reads/writes and memory 47%. "File": CPU 4%, Network < 15%, Disk 2 reads/writes and memory 19%. The maximum, minimum and average of the response time are 3.964s, 0.063s, and 2.308s.
- In 12VMs: the processed requests are 6500. The resource needs are: "App": CPU 8%, Network <15%, Disk 3 reads/writes and memory 42%. "File": CPU 22%, Network < 15%, Disk 6 reads/writes and memory 20%. The maximum, minimum and average of the response time are 3.138s, 0.005s, and 0.703s.
- In 24VMs: the processed requests are 10000. The resource needs are: "App": CPU 8%, Network <15%, Disk 3 reads/writes and memory 42%. "File": CPU 22%, Network < 15%, Disk 6 reads/writes and memory 20%. The maximum, minimum and average of the response time are 3.085s, 0.003s, and 0.423s. We also show the results in Fig. 8.

4.3. Scenario 3: Write of the Examination answers

We also use multiple-choice examination to simulate many students which want to write their examination answers back to the database at the same time.

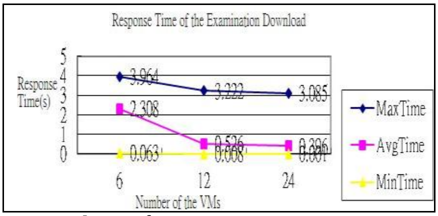

Fig. 8: The performance in Scenario 2.

- Students → "App": the examination answers.
- "App" → "WriteDB": the examination answers.
- "WriteDB" → "App": the status of the writes (success / fail).
- "App" → Students: the status of the writes (success / fail).

We define that an acceptable criterion is whether the write of the answers is correct or not. The result is shown as follows:

- In 6VMs: the processed requests are 2000. The resources needs are: "App": CPU 13%, Network < 15%, Disk 3 reads/writes and memory 45%. "WriteDB": CPU12%, Network<15%, Disk 6 reads/writes and memory 21%. The maximum, minimum and average of the response time are 4.148s, 0.189s, and 3.116s.

- In 12VMs: the processed requests are 2500. The resource needs are: "App": CPU 8%, Network <15%, Disk 3 reads/writes and memory 42%. "WriteDB":CPU17%, Network<15%, Disk 6 reads/writes and memory 20%. The maximum, minimum and average of the response time are 4.917s, 0.015s, and 2.994s.
- In 24VMs: the processed requests are 4000. The resource needs are: "App": CPU 7%, Network <15%, Disk 2 reads/writes and memory 41%. "WriteDB": CPU16%, Network<15%, Disk 7 reads/writes and memory 21%. In the criterion, the maximum, minimum and average values of the response time are 3.872s, 0.015s, and 2.971s. We also show the results in Fig. 9.

5. Conclusions

We have implemented the IGCS and have proven that the performance of the IGCS can be a few thousand people on the line. Besides, as shown in Fig. 6, the resources of the VMs can be scaled in/out according to the number of the participants in the IGCS. As a consequence, developers of the education platform could refer to our results to optimize the system's performance and leverage contents on the cloud for multiple users.

6. Acknowledgement

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7. References

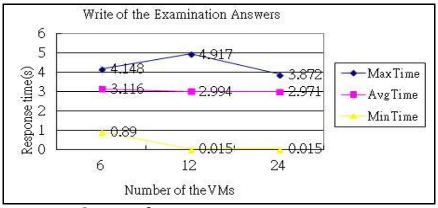

Fig. 9: The performance in Scenario 3.

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