Design Research on Open MOOC Platform

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Abstract

Online courses based on Internet technology are a new channel for high-quality and rich educational resources, which has facilitated acquisition of teaching resources and development of open resources. As a product of the Internet Age, open MOOC platform has seen further development in the era of mobile learning. However, videos on MOOC platform fail to work normally if the platform is used heavily, resulting in low availability of open MOOC resources. Given the situation, based on B/S architecture, the paper designs MOOC platform architecture within Java EE enterprise-level framework, and conducts data analysis and control through the interface layer, control layer and data layer. To verify scientificity and feasibility of the design, the paper employs JMeter for functional and performance testing, so as to test the online test management module of the open MOOC platform. Experiments show that the MOOC platform designed in this paper makes it possible for many people to use the platform concurrently.

Keywords: Open, MOOC Resources, Internet, Platform, Design Research.

1. RESEARCH BACKGROUND

1.1 Literature review

“MOOC” is an online course development model developed by people in the Internet Age, with the full name being Massive Open Online Courses (Yuan and Powell, 2013). MOOC is developed to increase the mode and efficiency of knowledge transmission, and is usually developed by organizations or individuals willing to share and cooperate with the help of Internet technology. With sharing of teaching resources becoming a reality, open MOOC platform also comes into being. As the latest online course development model, it has addressed the problems with traditional resource distribution and learning management, and incorporated information technology into the traditional learning management system, thus making it possible for learners to acquire open and diversified online resources (Skiba, 2012). On the one hand, open MOOC platform is quite appealing as it influences and complements the traditional classroom teaching, facilitates exploration of college education teaching modes, and helps improve the quality of teaching in colleges and universities (Lowenthal and Hodges, 2015). On the other hand, with popularization of compulsory education and increase in university enrollment, the threshold for receiving college education has been gradually lowered. But for some people, existing educational services and contents still fail to meet their needs. The reasons are as follows: First, there is still a threshold for college education, so some people can only get a high school diploma. Second, to meet people’s demand for self-improvement and for acquiring diversified knowledge in a personalized manner, traditional education models shall be complemented by online education (Nyoni, 2013). However, boom of MOOC platform is accompanied by some problems, such as the dropout rate up to 95%, which exposes a big problem with the MOOC platform - inconsistent quality of the courses (Rui, 2016). Some courses are boring and of poor quality, which reduces its appeal to users. Therefore, one of the solutions is to re-design the open MOOC platform to improve its role in the teaching process.

1.2 Research purpose

The paper aims mainly to design a more open MOOC platform that can manage and launch different courses and support concurrent use by many people. To this end, the paper first sums up the definition, features and advantages of open MOOC platforms generally accepted in the academic community, and then based on the B/S architecture, employs Java EE enterprise-level framework to design an open MOOC platform architecture. Then, to reduce the coupling of platform components, SQL Server 2014 and MVC design modes are adopted to extract data with JSP documents. Moreover, data analysis and control are implemented through the interface layer, control layer and data layer (Evans et al., 2016). To verify scientificity and feasibility of the design, JMeter is
adopted for functional and performance testing, so as to test the online test management module of the open MOOC platform. The range of score is between 0-140, and the test is conducted per score section. After that, test is conducted on the online video management module. By comparing the offset and throughput, the response time and the number of requests, it is concluded that the video server technology can take great concurrent pressure, especially when it comes to video processing. Therefore, the design can support concurrent use of the platform by many people. The designed open MOOC platform can guarantee normal playing of the teaching videos when a multitude of learners are using the platform; count the number of testees per score section in a test; and benefit more users as it is compatible with most mainstream browsers.

2. DESIGN AND IMPLEMENTATION OF OPEN MOOC PLATFORM

2.1 Theoretical basis for designing MOOC platform

In recent years, with the emergence of new teaching models like micro-lectures, MOOC, as an important carrier of teaching contents, has drawn wide attention from an increasing number of educators. Because learners can only maintain focused within a short period, it is urgent to build open MOOC platforms. One requirement for building such platform is that the teaching objective, time and content shall be featured by being “micro”, so the design of MOOC platform shall follow certain framework system (Terras and Ramsay, 2015). Some countries have already started the design and reconstruction of an architecture system, such as Britain. Some colleges in Britain have provided learning design with methods for selecting media tools and rich design resources, which are shared within the college. From the perspective of learning design architecture, the design shall be centered on the learners and detail the learning contents, so as to effectively enhance the learning results (Zhuhadar et al., 2015). Besides, after completing a course, the learners shall be able to understand the core competencies acquired. The framework attempts to guide students to accomplish the learning tasks with the learning results. Moreover, during the course design, the expected learning results can be achieved by accomplishing learning activities and assessment tasks; besides, resources, the instructor and communication tools are effectively integrated by centering on the learning tasks.

Through analysis of existing research on open MOOC platforms, it is found that a MOOC platform is a systematic teaching course system consisting of many micro-lectures and with a macro teaching objective. Thanks to careful teaching design of the instructor, the teaching objective, content and period are featured by being “micro”, and micro-videos are used as the core medium, watched by learners for learning and assessment purpose (Ng’Ambi, 2015). Every micro-lecture has the duration of 10 minutes and can adopt various teaching methods, such as skill observation, digital story and imparting knowledge. One or more teaching method can be used depending on the course progress and teaching content. As a “micro” teaching model, open MOOC platform has wide application in remote education, mobile learning and informal learning, and has drawn great attention from and been utilized by more and more educators (Khalil and Ebner, 2017). MOOC uses videos as the medium, and is easy to transmit online and available on mobile devices, which makes it convenient for learners to acquire relevant knowledge in a careful, independent and fast manner. Therefore, it has removed the restrictions on learning imposed by time and space, and encouraged learners to pay greater attention to the learning environment and learning transfer. Given the great advantages of MOOC, open MOOC platform can greatly reduce the burden on learners, effectively improve the learning results, and dramatically increase interactions between the instructor and learners.

2.2 Platform architecture design

Generally speaking, design of open MOOC platform’s framework is based on learners’ nonfunctional requirements and platform architecture; besides, the platform shall be open to the public and have such functions as registration, login, password modification and so on (Rhoads et al., 2015). This means that the platform shall make possible concurrent use by a great number of users. Therefore, the paper designs a platform based on B/S architecture and Java EE enterprise-level framework. Considering its openness, the MOOC platform has to process a lot of data information, which sets strict requirements for data complexity. Besides, the database shall be established based on data partitioning and distributed storage, so SQL Server 2014 is employed to determine the time and frequency of data use. Moreover, as the MOOC platform shall serve as a learning platform accessible to a great number of users, the server shall be compatible with data load balancing technology (Kanwar and Balasubramanian, 2014), which can effectively reduce the overall deployment costs. In this way, the MOOC platform makes it possible to launch a great variety of courses, and meanwhile allows many students to watch the videos concurrently at any place and at any time, thus greatly enhancing video server technology.
There are strict requirements for building the framework of an open MOOC platform, and for its maintenance and expansion in later stage. Therefore, the coupling between platform components shall be reduced (Kaplan and Haenlein, 2016), for which purpose the paper adopts MVC design mode. To meet the demand for expansion and maintenance of the platform system, decoupling of platform components is realized with 3 lightweight frameworks, namely, Struts2, Spring and Hibernate. Please refer to Figure 1 for the technical architecture of the MOOC platform. As is shown in the figure, the platform architecture is divided into the web layer, business logic layer, and data access layer. The web layer is under the charge of Servlet and responsible for transmitting data to the business logic layer, which is under the charge of Spring. After that, data is transmitted to the database for filtering, and then transmitted to the logic layer for interaction with the user. The main interactive mode is browser-based, and is aimed to facilitate friendly interaction.

![Figure 1. Technical Architecture of Open MOOC Platform](image)

### 2.3 Platform data model design

At this stage, to design the platform data model, the paper sets up three platform packages, with the specific process shown in Figure 2. First, JSP documents are adopted to extract data. The interface layer contains all the web pages of the platform, and is designed to receive various requests made by users and feed back the results to them. Second, request data is sent to users via action package and service package. The control layer is a collection of Action classes based on Struts2 technology (Walji, 2016). The classes in the action package receive the data submitted by web pages, encapsulate the data into business entity and then send it to the business logic layer. Data in the business logic layer is processed and then transmitted to the data layer for real-time processing. After that, the data is transmitted to the action layer, which feeds back to users the business data that has been calculated and processed via the browser. During the process, data in the database interacts with operations, and data flow is completed. Finally, when the platform needs to format the time-type data, tool classes may come to help. Alternatively, when the user gives uploading, downloading and other commands, the machine algorithm will eventually upload the file to the database or download it to a local folder.

![Figure 2. Platform Packages](image)
3. OPEN MOOC PLATFORM TEST ANALYSIS

Design and operation of the open MOOC platform also requires a series of functional and nonfunctional tests, with an aim to ensure stability of the system during the use (Lu, 2017). Functional tests are conducted to ensure that the functional modules can meet relevant functional requirements; besides, performance tests are carried out to ensure that the platform can meet the requirements for response time and data accuracy. To this end, the author used badboy test tool to record action script, adopted Apache JMeter method to test the static and dynamic performance of resources, and utilized JMeter to perform functional and performance testing. In addition, JMeter provides a graphical representation of the UI, which can visually display performance metrics or detect servers at high load. In view of this, the paper tests two major functions of the platform, namely, online test management module and online video management module. The hardware adopted in the paper is a desktop computer with the following parameters: Inter Core i7 2.5GHz*2 CPU, DDR3 2048MHz 8GB memory, and ADATA 500GB hard drive. Online test management module is subject to functional test with Win7 operating system and SQLSERVER 2014 database, and using such software as eclipse 4.4.2, flex 4.6, Red5-server-1.0.2 and so on. The range of score is between 0-140, and the test is conducted per score section. The test results are shown in Table 1.

Table 1 Test Result of Score Counting Function

<table>
<thead>
<tr>
<th>Label</th>
<th>#Samples</th>
<th>Average</th>
<th>Median</th>
<th>90% Line</th>
<th>Min</th>
<th>Max</th>
<th>KB/sec</th>
</tr>
</thead>
<tbody>
<tr>
<td><a href="https://localteach.cn">https://localteach.cn</a></td>
<td>124580</td>
<td>260</td>
<td>5</td>
<td>685</td>
<td>0</td>
<td>15224</td>
<td>2445.2</td>
</tr>
<tr>
<td>Error</td>
<td>96</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0.0</td>
</tr>
<tr>
<td>Total</td>
<td>125500</td>
<td>260</td>
<td>5</td>
<td>681</td>
<td>0</td>
<td>15224</td>
<td>0</td>
</tr>
</tbody>
</table>

It can be seen from Table 1 that, for a certain test, the platform can count the number of testees per score section and display the result in a line graph. Through relevant tests, the Q&A management function is proved qualified. The online video management module is then tested with the above-mentioned software, and Reports (a) and (b) are generated regarding the test results of video playing function, as is shown in Table 2.

Table 2 Test Results of Video Playing Function

(a) ActivaX Plug-in Test Aggregate Report

<table>
<thead>
<tr>
<th>Label</th>
<th>#Samples</th>
<th>Average</th>
<th>Median</th>
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<th>Min</th>
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</thead>
<tbody>
<tr>
<td><a href="https://localteach.cn">https://localteach.cn</a></td>
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<td>12</td>
<td>4</td>
<td>33</td>
<td>0</td>
<td>623</td>
<td>3421.2</td>
</tr>
</tbody>
</table>

(b) Flex + Red5 Video Server Test Aggregate Report

<table>
<thead>
<tr>
<th>Label</th>
<th>#Samples</th>
<th>Average</th>
<th>Median</th>
<th>90% Line</th>
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</tbody>
</table>

In JMeter test tool, the author set 1,000 simulated users who log onto the platform and play the video file. As a result, Reports (a) and (b) were generated, which indicate that, with 1,000 concurrent users, the number of requests (Samples) for ActivaX plug-in and Flex + Red5 video server is 125,500 and 50,213 respectively; the average response time (Average) is 260ms and 12ms respectively. The figures show that with 1,000 concurrent users, ActivaX plug-in has done a better job than Flex + Red5 video server in terms of page response time and request error rate. Besides, within the same response time, video server technology can successfully realize
video playing function, and ensure stable data throughput and offset. This shows that the video server can guarantee stable connection and data support. Therefore, by comparing the number of requests, offset and throughput, and the response time, it is found that video server technology can take great concurrent pressure when it comes to video processing, which makes it applicable to design a MOOC platform that allows concurrent use by many people.

4. CONCLUSION

To sum up, the paper designs an open MOOC platform and subjects it to functional and non-functional tests. The test data shows that two main functions of the platform are consistent with relevant functional requirements in our daily life. Regarding video playing function with heavy data traffic, non-functional test is conducted and the test result shows that video server technology adopted in platform design can meet applicable standards and support video playing in a continuous, stable and efficient manner. In a word, based on the results of various tests, the designed open MOOC platform has achieved the desired goal for overall function, and can be accepted. In the later stage, work is done based on SQL database, which involves join processing that will slow down overall response speed of the MOOC platform. Therefore, in future research, it is necessary to optimize SQL language.

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REFERENCES

Skiba D.J. (2012). Disruption in higher education: massively open online courses (MOOCs), Nursing Education Perspectives, 33 (6), 416.