A PRACTICE OF MOBILE LEARNING BASED ON CLOUD COMPUTING

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ABSTRACT

Information and communication technology are well known rapid growing industry in this decade. That is nearly the same as fast as growth in costs in education. Therefore, many people have been forced to find alternative ways to meet their education needs. Innovations of distance education create a new way to provide learning content, unlimited participation and open access through Massively Open Online Courses(MOOCs) via the web. In the addition, mobile learning centered research are sprouting out, anytime, anywhere, anyone learning is becoming what people aspire to. The published papers introduced mobile native applications, web applications and hybrid applications in order to enhance mobile learning. However, scalability becomes a common issue among all the solutions. In this paper, we tackle the scalability, collaboration, and content delivery problems by using cloud computing method aimed at making best effort to MOOC in mobile devices. Therefore, a practice of mobile learning is well designed and implemented based on cloud computing.

KEYWORDS

Cloud computing; mobile learning; mobile computing; mobile application

1. INTRODUCTION

MOOC, is one way of learning in networked world, has been around us for a while. A Mooc is a course, its open, participatory and distributed. It supports lifelong network learning that is education for all ages. MOOC is built for a world where information is everywhere. It is not just online course but a path to connect and collaborate while developing digital skills to waive engaging in the learning process[1]. In November of 2012, the New York Times declared 2012 “the Year of MOOC”. MOOC even had been touted as the first serious bit of competition of universities in the past thousand years. The main reason why MOOC become so popular is education cost grows too fast. For example, the growth in price of a college education has grown faster than prices in many other categories. People’s hunger of professional skills and knowledge from top academic intuitions also play important role in the blooming of MOOCs. It is maybe one of the most important events around which people who care about a topic can get together in work and talk about it in a structured way. Most likely, people have to pay to get the credit through an institution, but they are not willing paying for participating in the chargeable MOOC courses.

This is a new way that people really master knowledge because that all the work gets done in areas accessible for people to read and reflect in and comment on. It is also mean that all the people take the material put together by the facilitators and the work done by the participants, learners have to keep their work in order to share with others. People become part of the course by engaging with other people’s work. Participants are not been asked to complete specific assignments but rather to engage with the material with each other in with other material that may find on the web. MOOCS fits very well to several area knowledge and offers practice-oriented learning[2]. All of these features embrace MOOCs as a path toward professional skills and high-paying jobs without college degree approaching and paying for.

There are almost as many cell-phone subscriptions (6.8 billion) as there are people on the earth(seven billion) according to United Nations’s telecommunications agency[3]. In another words, it is almost everyone has a mobile phone. The phone like smartphone has already become the main information process device. When mobile phone first came out, it was the communication device that only manage wireless phone calls and text messaging. With the rapid development of telecommunication, the cell signal covers almost every

corner in the world. The smart phone can be used to watch videos with Youtube, make social network with Wechat and dealing with email. In fact, 21.6% of globe web page views goes through mobile device, and most of those users hardly use computer.

People has concerned about mobile device as the new media with very high expectation. It should be competent for learning content delivery, collaboration between participants and publishers, live streaming, survey, homework marking and so on. Mobile learning solution needs to take into consideration of all aspects of system with scalable, cross-platform design. Mobile device are born with these defects but not limited: bandwidth is narrow, easy loss, small screen and easily interfered signal. Mobile device manufactures also create some flaws: fragmentation of mobile phone operation system(OS) and hundreds of different screen sizes. Therefore, to produce one unique solution in order to integrate all sorts of OS and all kinds of different technique seems very complicated.

This paper introduce a mobile cloud computing solution to solve above problems by employing Cloud computing. The cloud computing based solution unleash the power of mobile device and ease publishers, developer and learners by reducing the cost of online resource. Some necessary tools also have been brought up that enable system with live stream, survey, file sharing capabilities. This is a highly scalable, reliable, and cross-platform solution. For demonstration, we designed a mobile learning MOOC course to practice the method of this paper.

The paper is organized by following structure: part II describe mobile learning at present, then we analysis mobile learning with cloud computing in part III; in part IV we dive deeply into cloud computing and come up with solution; part V compare the advantages and disadvantages among other available cloud computing platforms then design a demonstration in part VI and end up with VII.

2. RELATED WORK

Now, most of learning application running on the computer, therefore, it is not only a modification of the configuration files but also a redesign in order to run the program on mobile device. In mobile application development, there are two points: the first is mobile native app and the second is mobile web app. The realization of two methods is not the same with its own advantages and disadvantages. The mobile native app is an app that is built using native stack.

2.1 Advantages of Native app but not limited

2.1.1 Higher User Engagement

Native apps live on a user's home screen and it can be used offline. It also allows users to use apps in a more personal and interactive manner on a regular basis with little difficulties. Native apps have the ability to send push notifications and reminders to users, furthermore, increasing the possibility of brand interaction.

2.1.2 Smoother Experience

Native apps respond more fluidly to user, it gives better user experience.

2.1.3 Integration with Hardware

GPS or Motion detector modules can be directly integrated into hardware.

2.1.4 Commercialization is Easy

In-app billing, app payment and free options are available for mobile native apps.

2.2 Things need to be concerned for Developers

2.2.1 Mobile Native Apps are not Cross-Platform

It has to be designed for certain platforms that sometime become enormous time-consuming and over the budget. Although there are certain cross-platform development tools available in public, for example Xamarin, its high license price just reject most individual developers.

2.2.2 Updating is not Easy

Native app updates need lot of effort on developing and testing to program, and it needs to be downloaded and installed by clients to take effect.

As earlier mentioned, the alternative way is mobile web app. A web app is an app that built using HTML, CSS and Javascript for most part. Web apps have the following pros[4]: It is almost cross-platform, web app runs in multiple environment with the idea "write once, run everywhere"; No need to send updates through the app store, updates can be published anytime; Faster to prototype in HTML/CSS/JAVASCRIPT than native apps. Space saving; All the materials are downloaded from the web, saved mobile limited space.

Web apps have following cons:Web apps will never be as perform as it's native counterpart; Executing code in a browser-context is slower than the native context; There are so many limitations in mobile device comparing computer web browser; Web apps need to be online to run properly; The communication between web app and integrated hardware is a pain, and not elegant.

To solve all the above-mentioned issues, integrate the ability of cloud computing into mobile devices and maximum the advantages of mobile devices, there are some solutions produced by published papers. Using [5], author confirms some requirements and key technologies to implement cloud computing with mobile device. In paper [6], author illustrate MOOC as a revolutionary force that disrupt traditional higher education by expanding access and reducing costs. Using [7], a virtual cloud computing platform based on mobile device is shown, which is consist of nearby mobile devices by assembling a Ad Hoc network.

However, the collaboration between developers and learners is not included in those solutions. Therefore, this paper introduce a fine designed cloud computing solution that host data and applications within sina cloud computing platform. In helping collaboration, the solution with integration of mobile cloud computing can easily solve scalablity problems which was still bottleneck in other platforms.

3. MOBILE LEARNING AND CLOUD COMPUTING

People may have different points of view in mobile learning, but the center idea of common points is learning activities should be available anytime in any locations. Mobile learning is the intersection of mobile computing and e-learning, and mobile learning is defined as resource access with no location limitation, powerful search engine, efficient study, easy evaluation[8]. The mobile learning system is aimed to satisfy learner's anywhere, anytime studying style with open, easy access, massive knowledge.

The very basic objective of mobile learning is: 1)Open educational resources, sufficient course materials, effective evaluation[9]. 2)Learners should be more proactive in their education and in building their personal learning networks, they need to participate to get the most out of a MOOC. 3)The system has the ability to analysis the need of learners. 4)Cut down the cost to the bottom. 5)Delivery of learning, education or learning support everywhere. 6)Reforming traditional education, learner only focus on the interesting knowledge. 7)Improving the communication between learners and facilitators.

To achieve these mobile learning goals must rely on scalable, powerful, efficient computing network which is cloud computing technology. The main purpose of this paper is how cloud computing use in mobile learning, but not cloud computing itself. The content will refer some key technologies of cloud computing, exploring how those technologies were functioned in the mobile computing.

In brief, cloud computing is the practice of using a network of remote servers hosted on the Internet to store, manage, and process data, rather than a local server or a personal computer[10]. Cloud computing comes in four forms: 1) Public cloud. Public services provider offer the services and infrastructure off-site over the Internet with the high level of efficiency in public cloud; however, they are more vulnerable than private clouds. 2) Private cloud. Comparing public cloud, A private cloud is maintained on a private network. These clouds offer the greatest level of security and control, but they require a carefully planning of company. 3) Hybrid cloud. A hybrid cloud inherit a variety of public and private advantages with multiple providers. It is the trend of cloud computing in the future. The downside is that you have to keep track of multiple different security platforms and ensure that all aspects of your business can communicate with each other[11]. 4) Community cloud. A community cloud is a multi-tenant infrastructure that is shared among several organizations from a specific group with common computing concerns[12]. Such concerns might be related to regulatory compliance, such as audit requirements, or may be related to performance requirements, such as hosting applications that require a quick response time, for example[12].

Figure 1.Three different type of Cloud computing services

There are three different type of Cloud computing services:1) Software-as-a-Service(SaaS):is defined in [13], some defining characteristics are: web access to commercial software; Software is managed from a central location; Software delivered in a"one to many" model; Users not required to handle software upgrades and patches; Application Programming Interfaces (APIs) allow for integration between different pieces of software. 2) Platform-as-a-Service(PaaS): brings the benefits that SaaS bought for applications, but over to the software development world. PaaS can be defined as a computing platform that allows the creation of web applications quickly and easily and without the complexity of buying and maintaining the software and infrastructure underneath it.PaaS is analogous to SaaS except that, rather than being software delivered over the web, it is a platform for the creation of software, delivered over the web[14]. The example of PaaS include SAE, Amazon and so on. 3) Infrastructure-as-a-Service(IaaS):Infrastructure as a Service (IaaS) is a way of delivering Cloud Computing infrastructure – servers, storage, network and operating systems – as an on-demand service. Rather than purchasing servers, software, data center space or network equipment, clients instead buy those resources as a fully outsourced service on demand[15].

4. SINA CLOUD COMPUTING

Sina cloud computing platform is the leading PaaS platform in China, it is been chosen to represent cloud computing in this paper for instantiation. Applications are created and implemented in the cloud facilities by developers over the Internet. It is supplier's responsibility to keep the whole system running successfully, therefore, the cost of hardware purchasing and service maintain from content provider is almost reduced to zero. Publisher will have more energy to produce better MOOC materials and delivery better content. For a education institution, to run a web server not only need to configure web server to setup, but also, the internal and external firewalls have to be configured properly. Administrator of the web server have to make certain computer program running environment according to clients application design programming language. This will increase the size of technical team and operation cost of institution. According to the supplier's policy, education related applications have more privileges than applications other categories. Cloud builder wants to put best effort to delivery better online course to hungry for knowledge of the students. The hardware, software, services are well designed to work together, for example, load balancing, cache and storage, each of them has the most popular scheme. Some unique features of Sina Cloud engine is the reason why we gave up other platform:

4.1 Multiple Programming Language Support

Cloud Computing platform support some most commonly used programming languages, such as PHP, PYTHON, JAVA. Any of them can be used to create fascinating applications for background data process or web pages for mobile web apps with modern interfaces. Each programming language has its own SDK and documents.

4.2 Distributed Implementation

Application code is distributed to web servers in different locations. If one server power down or stop servicing, clients requests will automatically forward to the rest servers, client feels nothing. This improves user experience dramatically.

4.3 Efficient Load Balancing

By using “7 layer” load balancing technology, gateway server will analysis clients request content, and forward the request to the lowest load server. “7 layer” is a reverse proxy technology, which handle clients requests and check the backend server constantly in order to forward request only to the health one.

4.4 Sandbox

The sandbox attempts to isolate processes to protect process and whole system. Sandbox increase the value of application by isolating other user to read application.

4.5 Relational Database and No-Sql Database Support

By default, it support MySQL database. With the fashion of nosql, the system supports KVDB. Third part database management software can be use to manage MySQl even without modify one single line. In addition, database uses mater-slave prototype, this makes best effort of preventing data lost.

4.6 Multi-layer Security

The security is consist of sandbox, application firewall, password protection.

4.7 Powerful Service

The platform comes with some powerful services to developers. STROAGE handles big files, CDN speed up clients access based on the geographic locations of the users, MEMCACHE offers distributed cache service.

5. ADVANTAGES AND DISADVANTAGES IN MOBILE LEARNING

Cloud platform satisfy all different need of mobile learning, including mobility, learners interaction, communication between learners and facilitators, file sharing, live stream and so on, and this is why we recommend education institutions use SAE as mobile learning solution.

5.1 Advantages

5.1.1 It can integrate with Sina’s other Service, meet Different Need of Developers

Sina Email: Sina email service is one of earliest email providers, there are millions users on the web. It is convenient to use sina email because of large users and similarity. Sina vDisk: Sina vDisk is where documents, comments, pictures, ebooks, all sorts of electronic resource to save and share and it comes free to use. Weibo: Like Twitter© in the US, Weibo has the same influence in China. Weibo can be seamlessly embed into other suppliers services. Weibo is the best way for students to participant MOOC topics. It can publish learner’s thoughts and comments other peoples ideas which in turn helps deepen the learning experience.

5.1.2 Highly Scalable

When clients number jumps from millions to billions, system can smoothly shift up.

5.1.3 Server Management

Server management, data distribute, load balancing are all responded. Education institution only focus on the content of resource.

5.1.4 Security

Sandbox means the high security, data confidential, and reliability.

5.1.5 Multiple Language Support

At present, there are three programming languages available in SAE, they are: PHP, PYTHON and JAVA. Document of those three languages is also available.

5.1.6 Cost

It is absolutely free to start. When traffic and load among certain level, publisher will need to pay for the platform.

5.1.7 Easy to develop

In order to attract more developers and learners, its official website have tons of nice tutorials, it ease the development process. Developer will create fantastic application only need nice ideas.

5.1.8 High Reliability

For non-profit or commercial use, cloud can guarantee 90% of online time.

5.2 Disadvantage

5.2.1 Portability

Application configurations must meet cloud platform specific properties. When transform a application from Sina into other platform, application sometime need to be redesigned and plan.

5.2.2 Need More Support Language

As everyone know, the programming language like C is used so wildly. The lack of C programming language make this cloud platform less popular in certain developers. SAE has the right to support other common languages like, C#, Ruby.

5.2.3 Lack of In-Built Billing System

There is no in-built billing system, you have to employ this method by other third part company.

5.2.4 No Advertisement Publish

Most mobile application is free, developers use advertisement to gain incoming, the cloud platform should have this system to enhance application and increase incomes.

6. EVALUATION

In order to demonstrate the idea, we use two classes for experimental. One with traditional teaching method and another one with mobile learning method. Therefore, we name traditional teaching method class as Group A, and another one as Group B. Both of the classes use exactly the same syllabus, same content, same exercise, same teaching period and same lecturer.

However, Group B students have to watch tutorial video before the class and join the class conference in the middle of the class. Also, they need to post feedback on mobile learning conference website after class. The group A student will skip the part.

We carefully create a web app that contains all course related materials and conference website that receive and post all students feedback. All content of course is coded in HTML, CSS and Javascript. Study session could be established at anytime, with all different device. The content is optimized to adjust narrow screen and full screen. It is running in practice, hosted within Sina Cloud computing platform. The snapshot of web site is shown below in figure 2:

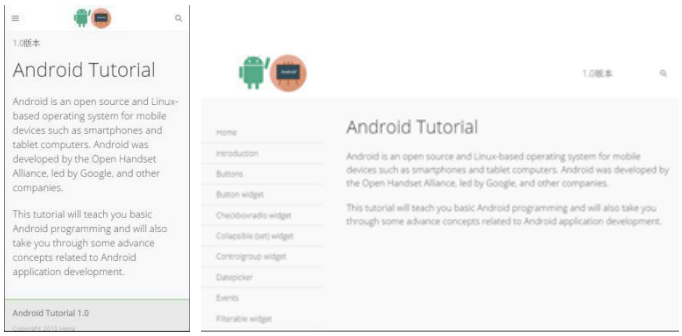

Figure 2. Same content in Samsung Galaxy IV and Galaxy Tab with different display. The navigation will be automatic hide if screen is not big enough. The MOOC course can be view from: http://kennyandroidtutor.sinapp.com

By tracking the content view history, it shows us the learners study anytime at convenience and access from all different location. Flexible access enable users no longer to rote, however, every topic can be viewed as many times as they wish.

The following table shows some analysis data between Group A and B students.

Table 1. Data analysis between Group A and B students

	Group A	Group B
Students number	53	49
Average score	62	78
Exercise number	14	17
Study hours/week	2	9
Feedback number	2	70
Wish to continue Android advanced study	5	23
Study evaluation	78%	90%

The average score between Group A and B is up to 16 that clearly shows Group B students have between study effect. However, in order to achieve higher score, the Group B students spend more than four times of Group A do.

The two groups have slightly difference in assignment numbers. Exercise effect do not strongly depend on mobile learning method.The most impact is continue learning influence. Almost half of the Group B students wish to carry on advanced study in the future comparing only 10 percent in Group A student wish to study further.

According to feedback, review video is the most popular feather in mobile learning method. Students have better understanding and interesting with review video capacity.

These result easily shows that a carefully designed website, mature course material and elegant tutorial videos combined mobile learning method with cloud computing implements improve study effect remarkably.

Figures should de numbered consecutively as they appear in the text.

7. CONCLUSION

In this paper, we have seen the benefits of cloud computing as a scalable solution for mobile learning. Mobile learner can study anytime, anywhere without computer limitations. The mobile solution fit all mobile learning requirements. Social apps and most available internet tools make cloud computing more powerful to collaborate and communicate. By employing cloud computing , education institution really cut down the cost and leave the hash of scalability. This is a right solution that can be implemented with great success by any institutions that would chose a cross-platform compatible approach to educational content delivery through the cloud to mobile learners. Finally, we implement this method in practice by setting up a online MOOC course and demonstrate the idea by data analysis.

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