A Model for Mobile Learning Applications on Virtual Private Cloud

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Abstract

Mobile Cloud Computing(MCC)provides a platform where mobile users make use of cloud services on mobile devices. The use of mobile clouds in educational settings can provide great opportunities for students as well as researchers to improve their learning outcomes and minimizes the performance, compatibility, and lack of resources issues in mobile computing environment. This paper proposed a MCC based learning modelto create aneffective learning environment for both the University and learnersby integrating virtualized private cloud technology with two components, social networking and mobile learning applications. This model will construct by using High Performance Computing Cloud Toolkit Ezilla and ubiquitous mobile learning elements. It willevaluate by UTAUT based model and Quality of Experience (QoE).

1. Introduction

Nowadays growth of technology is fast and unpredictable in the economy, industry,education and personal issues. One of the aspects of social life is the process of learning in universities, schools andother educational institutions. Extensive researches and huge investments have been carried outto develop technological learning in recent years.

Cloud Computing technology hasbrought greatopportunities to these technologicallearning environments. It has been driven bytechnologicalinnovations as collaboration software, service oriented architectures (SOAs), and data center virtualization. Cloud based mobile learning applications are introduced to overcome the limitations of the traditional mobile learning applications.

In cloud computing, virtualization can be a significant factor in performance loss of software applications because of interactions with the underlying virtual machine monitor and other virtual machines. Therefore, this proposed model will utilize the effects of virtual computing resources on performance of a mobile learning application in private clouds.

The adoption of cloud computing has unique security and privacy implications in mobileinformation systems. These aspects are related to ensuring that the data and processingcontrolled by a third party is secure and remains private, and the transmission of databetween the cloud andthe mobile device is secured [1]. Clouds provide access todata, but the challenge is how to ensure that only authorized entities can access the data.This requires a combination of technical and non-technical means, i.e. clients need to trusttheir providers and the providers need to ensure their technical competence and integrity. This approach provides highest degree of control over performance, reliability and security.Using the cloud principlesfor private cloud applications makes organizations better prepared to migrate or overflow toa public cloud provider when needed.

2. Literature Review

The term mobile cloud computing was introduced not long after the concept of cloud computing. It has been attracting the attentions of entrepreneurs as a profitable business option that reduces the development and running cost of mobile applications, of mobile users as a new technology to achieve rich experience of a variety of mobile services at low cost, and of researchers as a promising solution for green IT [7].

Mobile devices (e.g., smartphone, tablet pcs, etc.) are increasingly becoming an essential part of human life as the most effective and convenient communication tools not bounded by time and place. Mobile users accumulate rich experience of various services from mobile applications (e.g. iPhone apps, Google apps, etc.), which run on the devices and/or on remote servers via wireless networks. The rapid progress of mobile computing [10] becomes a powerful trend in the development of IT technology as well as commerce and industry fields. However, the mobile devices are facing many challenges in their resources (e.g., battery life, storage, and bandwidth) and communications (e.g., mobility and security) [4]. The limited resources significantly impede the improvement of service qualities. Cloud computing has been widely recognized as the next generation's computing infrastructure. It offers some advantages by allowing users to use infrastructure (e.g., servers, networks, and storages), platforms (e.g., middleware services and operating systems), and software (e.g., application programs) provided by cloud providers (e.g., Google, Amazon, and Salesforce) at low cost. In addition, Cloud computing enables users to elastically utilize resources in an on-demand fashion. As a result, mobile applications can be rapidly provisioned and released with the minimal management efforts or service provider's interactions.With the explosion of mobile applications and the support of cloud computing for a variety of services for mobile users, mobile cloud computing is introduced as an integration of cloud computing into the mobile environment. Mobile cloud computing brings new types of services and facilities for mobile users to take full advantages of cloud computing.

3. Materials and Methods

Cloud computing is an emerging area of distributed computing that offers many potential benefits to organizations by making informationtechnology (IT) services available as a commodity. When they contract for cloud services, such as applications, software, data storage, and processing capabilities, organizations can improve their efficiency and their ability to respond more quickly and reliably to their customers' needs. At the same time, there are risks to be considered, including maintaining the security and privacy of systems and information, and assuring the wise expenditure of IT resources.

This is a paid service usage model, with ready access to demand unlimited expansion metering pay features, including IaaS (Infrastructure-as-a-Service), PaaS (Platform-as-a-Service), SaaS (Software-as-a-Service) and three levels of service.

The virtualization of computing resources, as represented by the sustained growth of cloud computing, continues to thrive. Information Technology departments are building their private clouds due to the perception of significant cost savings by managing all physical computing resources from a single point and assigning them to applications or services as needed while remaining in control of their systems and information. As part of this trend, real time communication applications such as e-learning can be integrated with other software applications into one platform and deployed in private clouds to reduce capital expenditure and lower overall costs of daily based maintenance and real estate required for computer hardware.

As a critical component of private clouds, however, virtualization may adversely affect a real time communication application running in virtual machines as the layer of virtualization on the physical server adds system overhead and contributes to capacity lose.

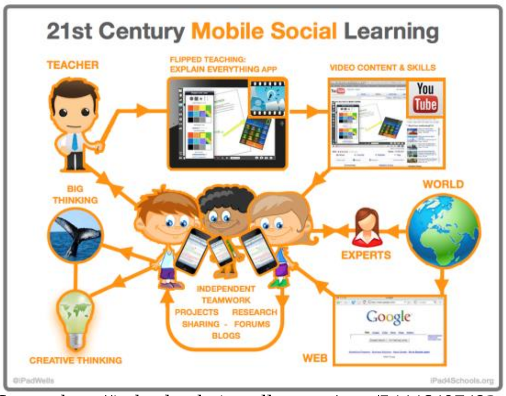
3.1.Virtual Private Clouds

A private cloud is hosted in the data center of a company and provides its services only to users inside that company or its partners. A private cloud provides more security than public clouds, and cost saving in case it utilizes otherwise un-used capacities in an already existing data center. Making such un-used capacities available through cloud interfaces allows to utilize the same tools as when working with public clouds and to benefit the capabilities inherent in cloud management software, like a self-service interface, automated management of computing resources, and the ability to sell existing over capacities to partner companies.

Virtual private clouds allow service providers to offer unique services to private cloud users. These services allow customers to consume infrastructure services as part of their private clouds. The ability to augment a private cloud, with on-demand and at-scale characteristics, is typical of a virtual private cloud infrastructure. Private cloud customers can seamlessly extend the trust boundaries (security, control, service-level management, and compliance) to include virtual private clouds.

3.2. Mobile Learning

Mobile learning (m-learning) is designed based on electronic learning (e-learning) and mobility. However, traditional mobile learning applications have limitations in terms of high cost of devices and network, low network transmission rate, and limited educational resources. Cloud-based mobile learning applications are introduced to solve these limitations. For example, utilizing a cloud with the large storage capacity and powerful processing ability, the applications provide learners with much richer services in terms of data (information) size, faster processing speed, and longer battery life [12]. The benefits of combining mobile learning and cloud computing to enhance the communication quality between students and teachers are presented in [9]. In this case, smartphone software based on the open source JavaME UI framework and Jaber for clients is used. Through a web site built on Google Apps Engine, students communicate with their teachers atany time. Also, the teachers can obtain the information about student's knowledge level of the course and can answer students' questions in a timely manner. In addition, a contextual mobile learning system based on IMERA platform [6] shows that a cloud-based m-learning system helps learners access learning resources remotely. Another example of MCC applications in learning is Cornucopia implemented for researches of undergraduate genetics students and "Plantations Pathfinder" designed to supply information and provide a collaboration space for visitors when they visit the gardens [10]. The purpose of the deployment of these applications is to help the students enhance their understanding about the appropriate design of mobile cloud computing in supporting field experiences. In [12], an education tool is developed based on cloud computing to create a course about image/video processing. Through mobile phones, learners can understand and compare different algorithms used in mobile applications. Figure 1 shows the general mobile learning applications on cloud system.



Source:http://inthecloud.gjmueller.com/post/54446407492 /how-mobile-social-learning-really-works

Figure 1. Mobile Learning Applications on Cloud

3.3.Ezilla

As virtualization technologies become more prevalent, Cloud users usually encounter the problem of how to build their own virtual cluster with a friendly user interface for virtual resource management. To help resolving this problem, an Ezilla, deploy private Cloud toolkit, has been developed by thePervasive Computing Team at the National Center for High-Performance Computing (NCHC).Currently, this effort of Ezilla integrates the de facto Cloud middleware, Web-based Operating System (WebOS), and automatic resource allocationmechanism to form a virtual computer in distributed computing environment. ThroughEzilla, with a click, Cloud users can customize and configure the specified virtual environment and virtual clusters. It is an extremely lightweight approach helping users to access virtual computing resources. The Ezilla toolkit leverages virtualization techniques and cluster scheduling policy. The main feature of Ezilla is simplifying a lot complexity of utilizing Clouds. Our goal is to make scientists or users painlessly run their jobs on Clouds. We will use Ezillain this model implementation [11].

4.Mobile Cloud Computing Model

MCC has been developed as a new paradigm for mobile applications, in which, instead of running mobile software on mobile devices, it will be transferred to a centralized and powerful computing platform in the cloud. MCC is an extension of Cloud Computing and Mobile Computing. It is the most emerging and well accepted technology with fast growth. The combination of cloud computing, wireless communication infrastructure, portable computing devices, location-based services, mobile web etc. laid the foundation for the novel computing model [14].

4.1. The proposed MCC Model

In this model, instead of a powerful processor and large memory on their mobile devices,mobile users can use memory and processors in the clouds to run their programs. Any user will connect to a private cloud environment, using his/her mobile device and username andpassword after authentication.In a private cloud environment, an effective andefficient learning application has been uploaded on one or more datacenters and has saved a profile for each user. The mentioned learning systemrecognizes and offers the appropriate educational content based on user's talent, priorknowledge and characteristics [3].

The application of cloud computing to create virtual and private learning environments waswelcomed by many institutions, since it reduced their costs and even sometimes made themfree.

We proposed to create a model combining cloud computing technology and mobile learning to create an educational cloud services, including a self-built cloud services (core functions) and external cloud services to function as a complete educational system. In addition, educational service providers can follow the completion of our research to the construct their own cloud with minimal IT knowledge support.

In a private cloud, an origination sets up virtualized environments on its own servers within its own data centers. One assumption is that the investigated targets will be limited to the organizations who still feel they absolutely cannot host their data outside of their firewalls due to privacy and legal issues, but they want to take advantage of the cloud computing architectures.

Another assumption for this research is the assessment of virtual machine settings that affect performance of multimedia is possible. Virtual RAM and virtual hard disk would accurately translate to the degree of impact in the analysis.

The proposed educational cloud will contain two core components of e-learning applications and Mobile learning Capability.

4.2. E-learning applications

4.2.1. Virtual Classroom

The virtual classroom is an interactive environment where the learners and instructor interact via computers. Such a network environment can be accessed via any mobile device that has Internet access. In a virtual classroom, the virtual learning environment can be created by using multimedia technologies that enable interactive content containing audio and video.

It realizes real time communication between teachers and students or students and students through virtualization technology, realizes cooperation at any place in the same assignment.

4.2.2. MobileElectronic Library

The learners can access from a variety of different contexts offered by University E-Library via their mobile device.

And will also contain the other additional e-learning functions including social network connection, online multimedia sharing offered by free external cloud service provider like Google, Amazon and Facebook.

4.3. Mobile learning Capability

4.3.1. Quick ResponseCode Application

By importing the QR code, the whole mobile learning cloud system gains the ability that education provider could easily use to provide the environment learning navigation function. The QRCode is a well-developed barcode system which has high information capacity and flexibility that can easily be created by the educator or accessed by the participator and learner.

4.3.2. The Context-Aware Exhibition Navigation Module

Exhibition navigation module provides the learners the concept of situational choices. Learners can choose from a variety of different contexts designed by education providers to participate. This module requires the combine effort of Education provider and IT supporters to formulate the important content of every single context configuration file (txt file), so that once the desired context isselected; it can be downloaded by the mobile web application from education cloud.

5. Evaluation of the Model

The characteristics and features of cloud computing and Mobile Learning will be inherited in Mobile Learning as a Services, making it reliable, flexible, cost efficient (due to the on-demand, pay-per-use costing model of cloud computing), self-regulated, and QoS-guaranteed. In addition, performing high computationally intensive applications (e.g., image retrieval, voice recognition, and gaming) on the cloud, called computation offloading, was shown to save energies on the mobile devices, thus extending the lifetime of their batteries**.**

Mobile Learning Cloud Environment can be mainly evaluated on both QoS and QoE aspects.

5.1. Quality of Services Aspects

QoSrefers to the technical aspects. It is defined as theability of the network to provide a service at an assuredservice level. QoS encompasses all functions, mechanisms and procedures in the network and the terminal that ensure the provision of the negotiated service quality between the User Equipment (UE) and the Core Network (CN). QoS is measured, expressed and understood in terms of networks and network elements, which usually has little meaning to a user. The reliability in service concerns throughput, delay and loss in data during transmission of data; service availability, security in terms of authentication as well as authorization, coverage area, and service setup time of the related bearer service; service retain ability, in general characterizes connection losses.

5.2. Quality of Experiences Aspects

QoE refers to the perception of the user about the quality of a particular service, or network, i.e. it depends on customer satisfaction in terms of usability, accessibility, retain ability and integrity of the service. QoE means overall acceptability of an application, or service, as perceived subjectively by the end-user. Quality of Experience includes the complete end-to-end system effects (client, terminal, network, services infrastructure, multimedia learning content, etc.). Overall acceptability may be influenced by user expectations and context.

However, the overall QoE is influenced by both QoS aspects and aspects of the service. QoE refers to the personal feelings of the customer about the quality of a service, and it expresses using perceptive words like ‘good’, ‘excellent’, ‘poor’. Since High Speed reliable and secured internet access is used at the University Campus Network it can be assumed that the network has excellent technical performances, .i.e.no QoS technical issues are present.

Therefore the main focus in this paper is directed towards the non-technical aspects of QoE evaluation of the mobile learning system in MCC environment, and its comparison to the conventional E-learning system in Cloud Computing environment.

In this model,QoE will evaluate through answering the survey questions by the students, teachers, researchers and learners from University of Computer Studies, Mandalayafter implementation of the model.

5.3. Hypotheses of Proposed Model

The Unified Theory of Acceptance and Use of Technology (UTAUT) model is one of the most widely used in the field of information and communication technology acceptance modeling which was developed by Venkatesh et al (2003). UTAUT could explain 70% of technology acceptance behavior (Masrom, Hussein, 2008) [13]. UTAUT consists of four key concepts that are, Performance Expectancy (perceived usefulness), effort expectancy (perceived ease of use), social factors and facilitating conditions that have a direct influence on intention to use it. The variables of gender, age, experience and voluntariness of use moderate the key relationships in theUTAUT model.

In UTAUT, these factors defined as follows: performance expectancy, which is "the degree to which an individual believes that using the system will help him or her to attain gains in job performance" , effort expectancy, which is "the degree of ease associated with the use of the system" , social influence, which is "the degree to which an individual perceives that important others believe he or she should use the new system" , facilitating conditions, which is "the degree to which an individual believes that an organizational and technical infrastructure exists to support the use of the system, and behavioral intention, which is "the person’s subjective probability that he or she will perform the behavior in question" .

After UTAUT model was considered,thismodel used six main factors based on UTAUT model that gave immediate effect to the intention to use in MCC based learning model.

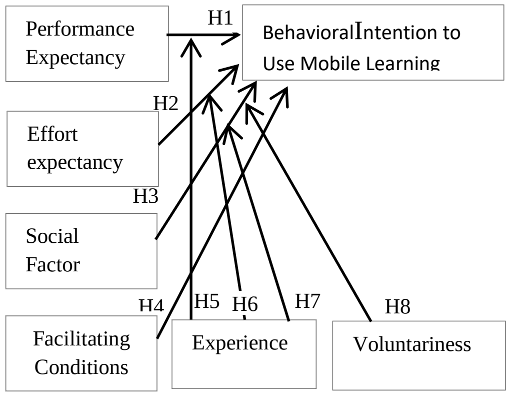


Figure 2. Hypotheses based on UTAUT

H1: Performance expectancy will have a positive influence on Behavioral intention to use.

H2: Effort expectancy will have a positive influence on Behavioral intention to use M-Learning.

H3: Social factors will have a positive influence on Behavioral intention to useM-Learning.

H4: Facilitating conditions will have a positive influence on Behavioral intention to useM-Learning.

H5: Experiencewill have a positive influence on Performance expectancyM-Learning.

H6: Experience will have a positive influence on Effortexpectancy.

H7: Experiencewill have a positive influence on Social factors.

H8: Voluntarinesswill have a positive influence on Social factors.

In this paper, preliminary questionnaires were distributed to the 18 research students in University of Computer Studies, Mandalay based on the above hypothesis.

5.3.1. Hypothesis Testing

This paper used Pearson product-moment correlation which provides numerical summary of the direction and the strength of the linear relationship between two variables (Pallant, 2003), giving a value between +1 and −1 inclusive, where 1 is total positive correlation, 0 is no correlation, and −1 is total negative correlation. It is widely used in the sciences as a measure of the degree of linear dependence between two variables. Knowing value of one of the variables does not assist in predicting the value of the second variable. Based on survey results, it can be said that all hypothesized relationships were supported.

6. Conclusion

Most of the people in University Campus already have at least one mobile device such as smart phone or tablet and these devices have a lot of popularity among users. This issue will pave the ground for the rise of mobile learning. The proposed model in this paper will be much appreciated in the future, because it is the result of the combined benefits of both mobile learning applications and cloud technologies. The applications can be run distantly and via mobile devices for the user in this model. One of the major components of the proposed model is the cloud computing which is responsible for computing and data storage required for mobile applications. This model will provide a way to share resources and services among different users and helps to make learning for all users at any location possible.

On the other hand, several teachers or professors from other Universities will alsoable to share documents and files needed for learners within clouds. Effective learning methods, programs and data will be uploaded on the data center layer within the cloud. This model's architecture will be based on multiple-layer architecture of mobile cloud computing.If the system willimplement with this proposed model, the relationship between qualityof service (QoS) and quality of experience (QoE) as a benchmark for measuring theperformance of cloud-based systems will require.It will makeeffective and efficient learning possible every-time and everywhere. It can save the battery life of mobile devices while using the learning system as well as raises the space of working memory and processing capacity of that system. It can also reduce learning costs and hardware dependency, and increases consistency, efficiency, security and reliability.

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