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Pervasive Learning using Cloud Computing

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Abstract: The popularity and continuously increasing trend in usage of the mobile and handheld devices have dramatically changed the human life style around the entire world. Currently, these devices are also being used in educational sector in general and for the distance learning in particular. Many higher education institutes have adopted distance learning as a mean to educate the physically disabled students and those whose physical movement is constrained due to some social or other issues. The distance learning can be provided through various means, however currently one of the emerging methodology of distance learning is Pervasive learning (P-learning). In contrast to prior distance learning methodologies, such as Electronic learning (E-learning) and Mobile learning (M-learning), P-learning is getting significant attention from academic as well as professional researchers' community. Various models and frameworks have been proposed by researchers to adopt P-learning, however each of them has some tread-offs. In this paper, we have also proposed a model to implement the P-learning system. In contrast to prior work, the proposed model is cost effective and flexible solution to P-learning.

Keywords: Distance learning, cloud computing, E-learning, M-learning, P-learning.

1. INTRODUCTION

The technological advancements and modernization have significantly changed our daily life style. Particularly, the emergence of modern smart phones and other hand-held devices have reshaped the ways people interact with each other. These modern devices have many applications ranging from as a tool of interaction or communication to entertainment and learning. Nowadays, these smart devices are also playing an important role in teaching and learning environments in general and in distance learning in particular. Distance learning can be classified as E-learning, M-learning and P-learning. The concept of E-learning is very simple. It refers to the remote learning through utilizing various electronic equipment, such as computers and the Internet as well. M-learning is similar to the E-learning except that it supports mobility in learning process. Students can have access to learning material through their hand-held devices, such as personal digital assistants (PDAs), notebooks, tablets and mobile phones. In contrast to E-learning and M-learning, P-learning is an emerging field in distance learning that can help individuals to acquire knowledge anytime-anywhere by exploiting the modern smart pervasive devices. The main idea of P-learning is that the knowledge/ information should follow the user and become available to him whenever and where ever he needed it (*Graf et al.,* 2009).

P-learning provides learning enhanced atmosphere with intelligent and context awareness features. While the learner is moving with his/her mobile device, the system dynamically supports his/her learning by communicating with the embedded devices in the environment. It provides flexibility for learner in terms of time and managing the resources used in learning process. In order to realize P-learning environment practically, it requires several hardware and software resources and a framework that dictates how these resources be interconnected. Continuous innovation in information communication technology (ICT) and in hand-held devices have imposed new requirements on distance learning systems in general and P-learning in particular. Consequently, it is the need of time to propose and develop new models that are more sophisticated and frameworks to deploy P-learning system. In view of these facts, in this paper we propose a framework to deploy P-learning system. The proposed framework exploits Cloud technology for P-learning systems that offers several benefits over existing models and frameworks especially in terms of cost and resource utilization.

In this paper section 2 discusses the background of P-learning. Section 3 is materials and methods in which the fundamental concepts of cloud computing technology are discussed. This section also describes the proposed approach to deploy P-learning systems. Section 4 is the discussion and finally section 5 concludes the paper.

2. BACKGROUND

In traditional teaching and learning environments, the common method of interaction between teacher and

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students is face-to-face conversation. In these environments, teachers physically come in the classroom and teaches the students. Students have to attend the class on the regular basis. Despite of its popularity, this system of imparting education have some disadvantages, such as lack of efficient classroom equipments, huge number of students' enrolment in a class and the dearth of classrooms. In addition, students who are unable to attend the classroom due to cultural and traditional barriers, physical disability or employment are not facilitated in any manner in the traditional teaching and learning environment. To overcome these problems, distance learning system was introduced. In this system audio and/or video lectures and written correspondence was used through exploiting various ICT tools and techniques (Girginer, 2002). Learning material is produced and delivered in digital form instead of the printed form. The next phase was utilization of multimedia and hypermedia technologies that enabled the delivery of learning material through CDs/DVDs and improved the effectiveness of learning (Yue *et al.* 2008). Rapid development of internet and world wide web (www) lead to web based learning environments. It facilitated the learners to access the learning material from anywhere, at any time.

Distance learning is categorized into three main categories, i.e: E-learning, M-learning and P-learning. E-learning has some benefits over traditional face-to-face learning. It provides flexibility to learners in managing the time for learning and also reduces the expenses in terms of travel and printing costs. It also provides the facility to learn at their own place and feasible time with the help of computer and internet facility. E-learning has some disadvantages as well. For example, many learners are not computer literate so they find difficulty in using E-learning systems. In traditional face-to-face learning system, students have strong bonding among themselves as well as with the teachers. This lacks in E-learning systems.

M-learning is the extension of E-learning in that it allows access to the web based data through hand-held devices, such as tablets and mobile phones. Due to the advancements in ICT and reasonable prices of hand-held devices, students not only use them for communication purpose but also for learning. In fact, nowadays almost every person have one or more hand-held devices, especially the mobile phone, that has changed the learning methodology from e-learning to m-learning. Technologically m-learning have some benefits over e-learning educational system. M-learning uses GPRS and Bluetooth for data transfer and sharing. It is always connected and networked. It is lightweight, allows audio and video teleconferences, has no geographical boundaries, flexible timing on 24/7 basis.

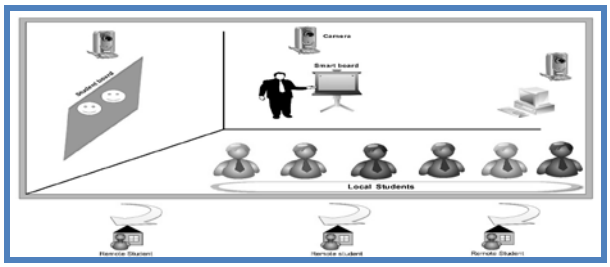


Fig. 1. A Pervasive (smart) classroom model for P-learning (Koondhar, 2015)

Fig.1 illustrates the scenario of P-learning. It offers more benefits as compared to the E-learning and M-learning. According to (Yahya, 2013) P-learning environment consists of following six components: **Community:** Learners have more than one teacher.

1. **Autonomy:** Learners free from central authority.
2. **Location:** Learning is not bound with classroom. Learners can learn from any place.
3. **Relation:** Learners can learn inside their own individual surroundings.
4. **Context Aware:** The environment must be smart to provide learning material related to the context.
5. **Adaptability:** The system should adapt or reconfigure according to contextual changes.

The main concept of P-learning is that information should follow the students so that it will be available to them whenever and where ever they needed it in a secure and timely manner (*Graf et al.,* 2009). The issues and challenges of P-learning systems are due to the integration of both technical and educational systems into a single system. As the student is not fully computer literate person, so it requires an easy and friendly user interface so that students can efficiently use it. Since P-learning systems are consisting of heterogeneous devices and exploits heterogeneous networks for connectivity, they require software and hardware based tools and techniques that enable interactions between the devices that constitute the learning environment. (Kaewkiriya & Utakrit, 2012). In order to cope with the above mentioned challenges of P-learning environments, researchers have proposed several solutions each of which has its own trade-offs in terms of cost, efficiency, security, hardware/software requirements, etc. In contrast to prior work, in this paper we have proposed a model for P-learning environments based on cloud computing technology.

3. MATERIALS AND METHODS

In this section, we discuss the concepts, tools and methods utilized in the proposed P-learning model.

3.1 Cloud Computing

Cloud computing can be defined as a collection or group of remote machines containing server software interconnected through a network that allows

centralized data/information storage and retrieval. It also allows access to various computing resources and services remotely.

According to (Sosinsky, 2011), cloud implies following things:

- **Abstraction.** The subtle element of system execution is escaped the end user, information is put away in areas which are obscure to the end users and system development and support is outsourced.
- **Virtualization**. Technical assets including capacity, server, application and system are virtualized to give usage autonomous base and with flexible scaling. Expenses are evaluated utilizing pay by utilization with metering.

Thus, this kind of cloud-based environment does not require the purchase of any software or hardware equipment for the usage of any application. In this way, it serves to decrease the speculation on fittings assets and IT support group (Viswanath, 2012). This environment is focused around a building design that joins administration, resource administration, virtualization and combination, data foundation, vitality productivity, security and strength (Saurabh, 2011). Traits of Cloud computing can be acknowledged from its correlation with the legacy computing as per below **(Table -1):**

Area of Difference	Traditional Computing	Cloud Computing
Acquisition Model	Buy asset, Build Technical Architecture,	Buy Services, Architecture included,
Business Model	Pay for Assets, Administrative overhead	Pay for use, Reduced Admin function
Access Model	Internal Networks, Corporate Desktop	Over the internet, Any Device
Technical Model	Single tenant, Non-shared, Static	Multitenant, Scalable, Elastic, Dynamic
Delivery Model	Costly, Lengthy Deployments, Land and Expand Staffing	Reduced Deployment Time, Fast ROI.

Table-1: Differences between traditional computing and cloud computing

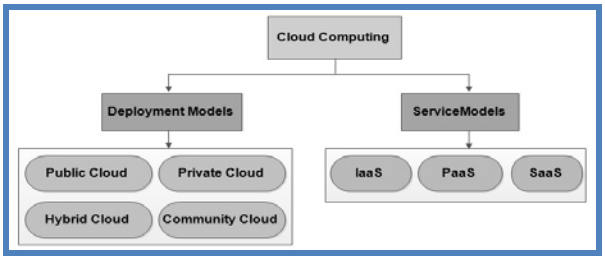


Fig.. 2 .Cloud computing types, models and services

NIST (National Institute of Standards and Technology) has classified cloud computing into two fundamental models on the basis of working definitions (High, 2013):

Deployment Models: include the controlling and location of cloud structural design.

Service Models: contain specific services which can be obtained to by means of cloud computing platforms.

The NIST further categories the deployment models into public cloud, private cloud, hybrid cloud and community cloud (Sosinsky, 2011).

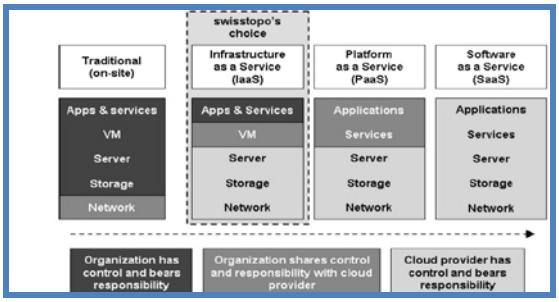


Fig. 3. Overview of Cloud computing services.

Service models are categorized as follows: (1) Infrastructure as a Service (IaaS) (2) Software as a Service (SaaS) (3) Platform as a Service (PaaS).

3.1.1 Advantages and Challenges

Nowadays cloud computing is widely used because:

- **Self-service on demand:** An end user can utilize resources without any connection with the cloud service provider.
- **Resource pooling:** Cloud computing supports multi inhabitant utilization where cloud service provider makes resources available so that end users could access the required resources easily.
- **Pay every utilization model:** The users of cloud are charged according to the usage of cloud resources.
- **Anytime-Anywhere:** Since access to the resources is given so by using hand-held devices, end user can access to their required resources anytime-anywhere throughout the day (i.e. 24/7).
- **Reduced Cost:** Since cloud computing service providers offer both software and hardware services, companies and organizations have an opportunity to reduce the overall cost required to meet their ICT requirements through reducing the number of technical staff. Companies also eliminate the expenses of buying the special software or hardware.

3.2 The Proposed Model for P-Learning

With high increase of student enrolment for higher studies, fast development of educational substance and transforming IT base, institutes are facing sensational boosting expenses that prompts the need of some options for P-learning arrangements. Likewise, the traditional educational management systems are not versatile to for effective utilization of assets. To expand the effectiveness and accessibility of existing learning management system, the institutes can assume a result oriented pedagogy. The possible effectiveness of utilizing cloud computing as a part of advanced

education has been perceived by numerous colleges, for example, Washington State University's School of Electrical Engineering and Computer Science, College of California, advanced education organizations from Africa, UK, US and others (Mircea and Andreescu, 2011).

In cloud based P-learning system, the institutes are in charge of content creation, administration and content delivery, while the cloud computing service providers are in charge of system development, improvement, maintenance and administration.

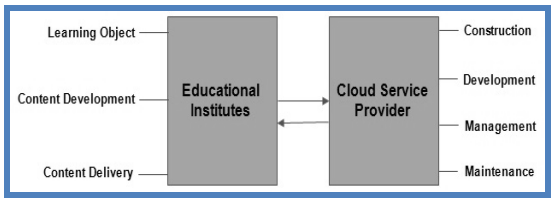


Fig. 4: Different activities of Educational institutes and Cloud service provider

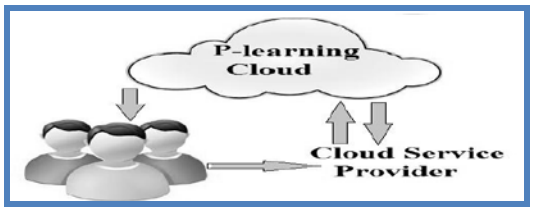


Fig. 5. A Proposed model for P-learning using cloud computing.

The working mechanism of the proposed approach is as follows: the end user initially sent a request to the cloud service provider and cloud service provider will connect with the P-learning cloud in response to end user's query. This structural design has infrastructural layer, software resource layer, resource management layer, three service layer and application layer.

4. DISCUSSION

Cloud computing is a processing model focused around networks, whose main goal is to guarantee that the end users can essentially utilize the computing resources on demand and pay cost as indicated by the utilization of the resources (Huang, 2012). Unique features of cloud computing are, from one viewpoint, the utilization of assets on demand and then again, the straightforward versatility (A. Fernandez, 2012). We advocate that the P-learning based on cloud computing could emerge as a financially cheaper and effective as compared to the traditional P-learning systems. Microsoft, Yahoo, Google, and Amazon are among some Cloud computing service providers who offer free of cost support for educational systems. Assimilation of P-learning with cloud computing not only helps in managing learning contents efficiently, but also provides an opportunity to reduce the overall cost required to deploy the P-learning system.

5. CONCLUSION

P-learning is attaining huge acceptance in teaching and learning environments due to its advantages and flexibility in learning. To build the infrastructure of P-learning and make it operational various software and hardware devices, lots of human capital, financial investment are required. One of the alternate to overcome these problems is the idea of using cloud-computing technology. In this paper, a theoretical model for P-learning systems in cloud computing is proposed to offer a cost effective and efficient solution to the educational system.

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