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A FRAMEWORK FOR BUILDING E-LEARNING RESOURCES IN THE CLOUD

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Abstract

Cloud computing is becoming a technology of choice when any organization wants to reduce the cost of software and hardware infrastructure. It is particularly useful for institutions because the resources put in the cloud can be accessed by students anytime, anywhere and using any device which include cheap hand held products and smart phones. This paper reviews the benefits of cloud computing technology and presents a model for building e-learning resources in the cloud. Object oriented methodology is adopted for the analysis and design and Unified Modelling Language (UML) is used to construct the model.

Keywords: *Cloud computing, E-learning, Framework, Unified Modelling Language, Smart phones*

Introduction

Advancements in Information and Communication Technology (ICT) has changed the way teaching and learning are being abstracted, designed and implemented. It gives a host of options for the design, construction, and use of e-learning resources. E-learning is an alternative platform for education. It deployed electronic media and information and communications technology (ICT) to support teaching and learning (Yamin, Ishak, and Ibrahim, 2014). Today a modern learner can connect to e-learning resources anytime and anywhere and making use of ICT tools such as smart phones and tablets, which make learning more flexible and interactive, cutting off the constraints of the traditional classroom setting.

Institutions and funding

In this era of economic recession, the sources of funding academic institutions, both private

and public, and small or big, are nose-diving and education managers are looking for ways to keep moving the institutions forward. Deploying e-learning, which is considered to be an alternative platform for education, is capital intensive because it requires the institutions to purchase a host of IT infrastructure (software, hardware, routers, storage, and network resources) to be effective. One way to solve the funding problem is to adopt cloud technology by building the e-learning system in the cloud. This way, every institution (small or big) can enjoy the inherent benefits of cloud computing technology.

Cloud Technology

Cloud computing technology is a paradigm that has been defined by several authors (Vouk, 2008), (Buyya et al.,2009). Ajuwon and Oladele (2016), regarded it as a general term for anything that involves delivery of services that are hosted over the internet. The researchers agreed that it allows the users to access the applications using the web browsers as if it is done on their own personal computers, mobile phones, or personal digital assistants. While Atayero and Faseyitan (2011), saw Cloud computing as a concept resulting from natural evolution of our everyday approach to using technology delivered via the Internet, Arora and Parashar (2013) corroborated this by defining Cloud Computing as the ability to access a pool of computing resources owned and maintained by a third party via the Internet. According to Wikipedia (2017), Cloud computing is the on-demand availability of computer system resources, especially data storage and computing power, without direct active management by the user. The term is generally used to describe data centers available to many users over the Internet. However, US National Institute of Standards and Technology (NIST) adopted the definition provided by Mell and Grance (2011) thus:

> *Cloud computing is a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction. This cloud model is composed of five essential characteristics, three service models, and four deployment models.*

Mell and Grance (2011), advanced the following five essential characteristics, three service models and four development models:

Essential Characteristics

On-demand self-service: A consumer can unilaterally provision computing capabilities, such as server time and network storage, as needed automatically without requiring human interaction with each service provider.

Broad network access: Capabilities are available over the network and accessed through standard mechanisms that promote use by heterogeneous thin or thick client platforms (e.g., mobile phones, tablets, laptops, and workstations).

Resource pooling: The provider's computing resources are pooled to serve multiple consumers using a multi-tenant model, with different physical and virtual resources dynamically assigned and reassigned according to consumer demand. There is a sense of location independence in that the customer generally has no control or knowledge over the exact location of the provided resources but may be able to specify location at a higher level of abstraction (e.g., country, state, or datacenter). Examples of resources include storage, processing, memory, and network bandwidth.

Rapid elasticity: Capabilities can be elastically provisioned and released, in some cases automatically, to scale rapidly outward and inward commensurate with demand. To the consumer, the capabilities available for provisioning often appear to be unlimited and can be appropriated in any quantity at any time.

Measured service: Cloud systems automatically control and optimize resource use by leveraging a metering capability1 at some level of abstraction appropriate to the type of service (e.g., storage, processing, bandwidth, and active user accounts). Resource usage can be monitored, controlled, and reported, providing transparency for both the provider and consumer of the utilized service.

Service Models

Software as a Service (SaaS): The capability provided to the consumer is to use the provider's applications running on a cloud infrastructure. The

applications are accessible from various client devices through either a thin client interface, such as a web browser (e.g., web-based email), or a program interface. The consumer does not manage or control the underlying cloud infrastructure including network, servers, operating systems, storage, or even individual application capabilities, with the possible exception of limited user-specific application configuration settings.

Platform as a Service (PaaS): The capability provided to the consumer is to deploy onto the cloud infrastructure consumer-created or acquired applications created using programming languages, libraries, services, and tools supported by the provider.3 The consumer does not manage or control the underlying cloud infrastructure including network, servers, operating systems, or storage, but has control over the deployed applications and possibly configuration settings for the application-hosting environment.

Infrastructure as a Service (IaaS): The capability provided to the consumer is to provision processing, storage, networks, and other fundamental computing resources where the consumer is able to deploy and run arbitrary software, which can include operating systems and applications. The consumer does not manage or control the underlying cloud infrastructure but has control over operating systems, storage, and deployed applications; and possibly limited control of select networking components (e.g., host firewalls).

Deployment Models

Private cloud: The cloud infrastructure is provisioned for exclusive use by a single organization comprising multiple consumers (e.g., business units). It may be owned, managed, and operated by the organization, a third party, or some combination of them, and it may exist on or off premises.

Community cloud: The cloud infrastructure is provisioned for exclusive use by a specific community of consumers from organizations that have shared concerns (e.g., mission, security requirements, policy, and compliance considerations). It may be owned, managed, and operated by one or more of the organizations in the community, a third party, or some combination of them, and it may exist on or off premises.

Public cloud: The cloud infrastructure is provisioned for open use by the general public. It may be owned, managed, and operated by a business,

academic, or government organization, or some combination of them. It exists on the premises of the cloud provider.

Hybrid cloud: The cloud infrastructure is a composition of two or more distinct cloud infrastructures (private, community, or public) that remain unique entities, but are bound together by standardized or proprietary technology that enables data and application portability (e.g., cloud bursting for load balancing between clouds).

Benefits of cloud computing

Here, ten(10) benefits that can be derived from the adoption of cloud technology are discussed:

Low capital investment

Cloud technology does not mandate the user to invest on sophisticated infrastructure such as servers, routers, network, and storage, before adoption. In cloud computing, infrastructure is hired, so the cloud user is not worried about the price or changes in the price of infrastructure, these costs are easily controlled, and there may be no capital investment. The cloud user only needs to consider the returns on investment (ROI). It is a case of "invest nothing, but own everything".

Managed infrastructure risks

The user is not worried about the risks involved in acquiring any IT infrastructure. All risks are taken and managed by the third party (cloud service provider). The provider determines the best technology to employ and deploy. He takes all the financial and natural risks, maintains all the equipment, and manages all the resources without making recourse to the cloud users.

Accelerated Deployment

Cloud technology is easy and fast to deploy, because the startup costs, which would typically need securing of management approvals before the project can commence, is no longer required. The decision to adopt the technology is also made easier because all the requirements analysis had been executed by the service provider. The user only needs to ensure that his requirements are met and adequate service level agreements are made.

Efficient resource utilization
The technology allows for efficient resource utilization because the user is not worried about changes in licenses or maintenance agreements on the software, hardware, storage, routers, and network infrastructure, not even how they are connected or deployed. Since these resources are hired, utilization is put in the hand of the service providers who keep a pool of users, and who can hire the best experts to manage the resources effectively and efficiently.

Flexible pay per usage (pay-as-you-go)
Payment for cloud resources is based on usage. The user pays only when the service is used, and can specify flexible time of use and terms of payment. Payment terms can be weekly, monthly, or annually. This payment is low because it is spread and shared among a pool of cloud users.

Service anywhere and anytime
The user can access the cloud service anywhere and anytime. Because of the ubiquitous nature of the technology, the user is not confined to a specific place or location to use the service. Cloud technology allows mobile access to corporate data, this offers more flexible working conditions to users so they can work anywhere and anytime and keep instant updates with clients and colleagues.

Use of varied technology
The user is allowed to use any device to connect to the cloud. The technology can accept any type of devices for connection. So any device within the financial capacity of the user is acceptable. Devices such as smart phones, tablets, pagers, and other personal digital assistants can be used.

Competitive advantage
Cloud technology gives the users a competitive advantage by making the most innovative and latest technology available. By providing and managing the underlying infrastructure, it enables the users to focus on other priorities that can grow the business and give them a competitive advantage. Again, adopting the cloud technology gives access to enterprise-class technology, and the Pay-as-you-go service allows small business outfits to compete with the big organizations.

Disaster recovery
Disasters is usually beyond the control of any organization. However, Cloud technology provides backup and quick recovery for all kinds of emergencies.

Cloud users can therefore, minimize downtime occurring from incidence of disasters, which can lead to loss of revenue and brand reputation, and quickly recover from natural disasters.

Automatic updates and upgrades of resources

Since cloud service providers provide and manage the underlying infrastructure, cloud users enjoy automatic updates of software, hardware, and other network resources. Cloud-based resources are automatically refreshed after updates and organizations are saved from having to wait until software updates are installed or hardware are upgraded. This saves users' time and money spent on IT consultants and vendors for updates and upgrades of resources.

The objective of this work however, is to provide a framework for building e-learning resources in the cloud for educational institutions so that they can enjoy the benefits of cloud computing technology.

Proposed Framework For Building E-Learning Resources In The Cloud

In this framework, two windows are provided, one window for the staff of ICT or IT department to register students matriculation numbers, names, departments, pictures and courses, and accredit students for the use of the e-learning resources, and for the lecturers to upload e-learning resources, and another window for the students to access the e-learning resources.

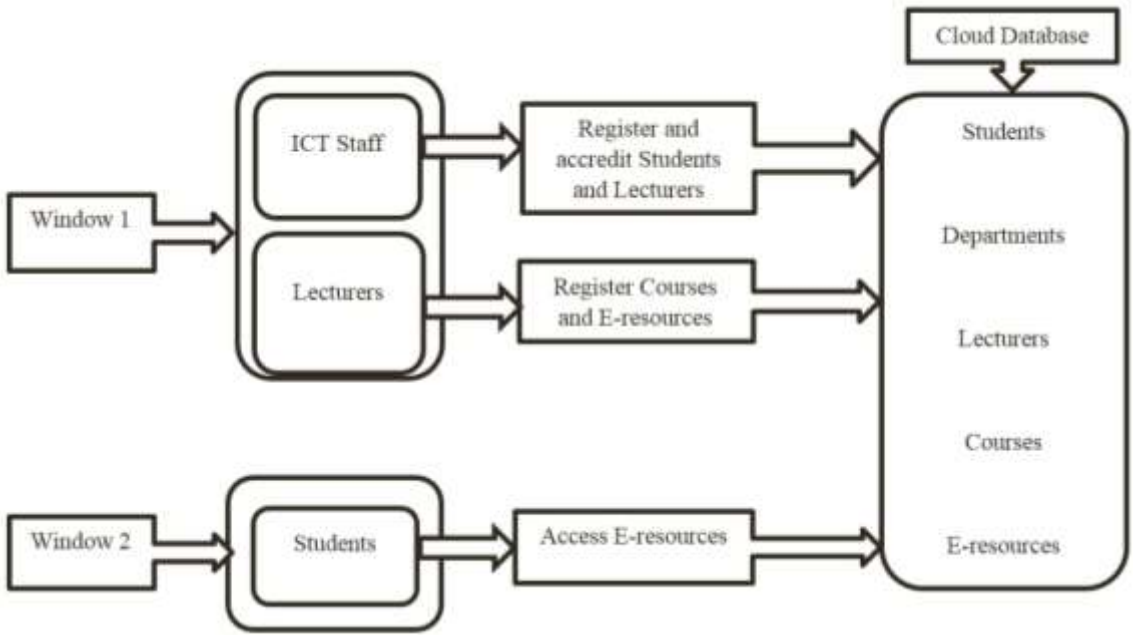

Figure 1: Conceptual view of building E-learning resources in the cloud

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Methodology

Object oriented methodology is used to analyse and understand the problem domain, and identify the actors and how they interact. Unified Modelling Language (UML) is used to construct the Use Case diagram, Class diagram, Sequence diagram, and deployment diagram.

Use Case Diagram of the model

The use case diagram is used to identify various actors (objects), and show the interaction of each actor with the system. Five actors are identified:

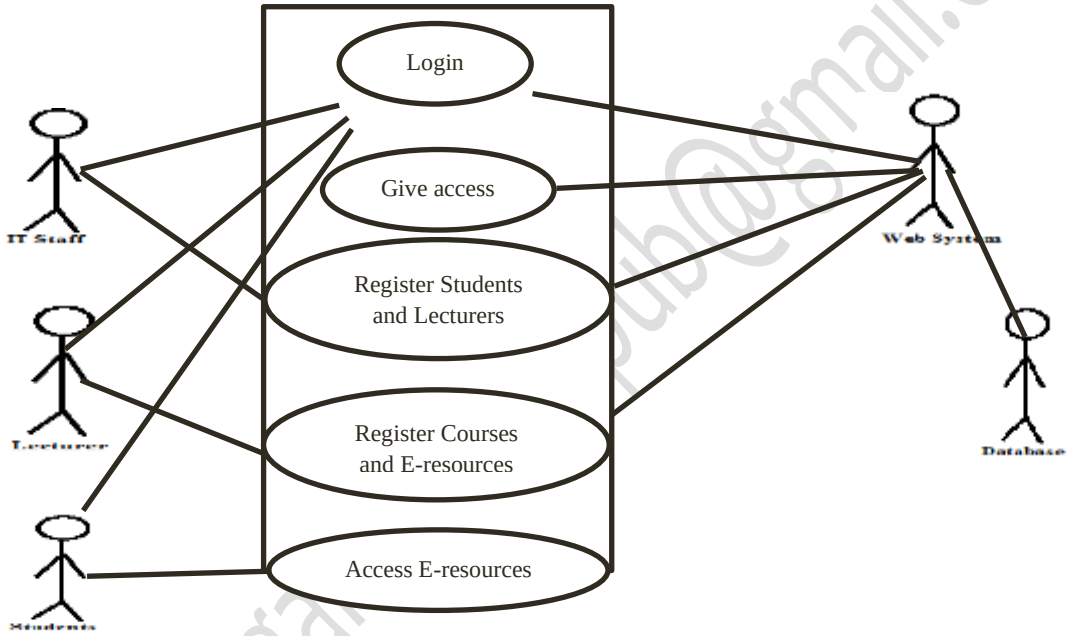

Figure 2: Use Case diagram

Class Diagram of the model

The Class Diagram is used to identify the classes, specify the services which are provided by each class, and model how the classes are related to one another. Four classes are identified:

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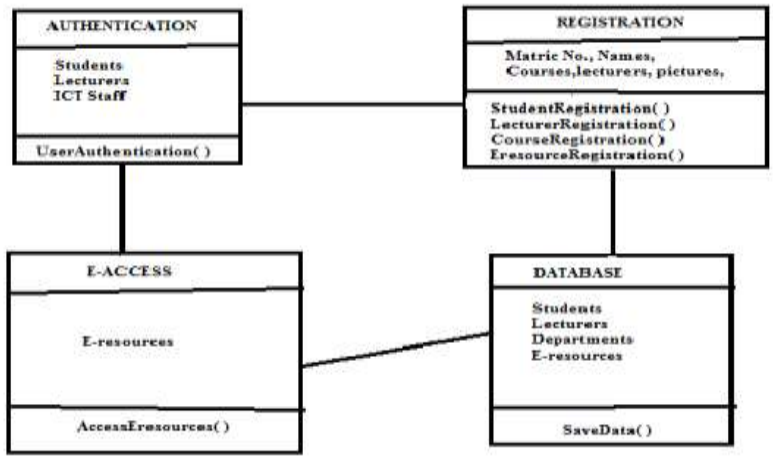

Figure 3: Class diagram

Sequence Diagram of the model

Sequence diagram models the dynamic interaction and the flow of control between the identified actors:

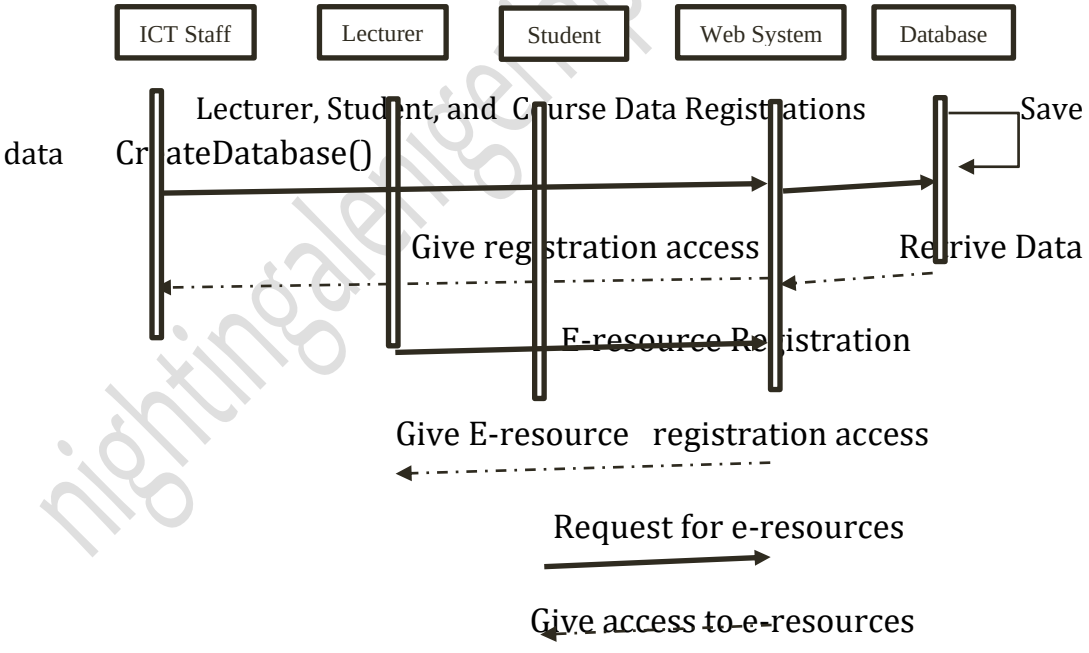

Figure 4: Sequence diagram

Deployment Diagram of the model

The deployment diagram describes the hardware components on which the software will be deployed.

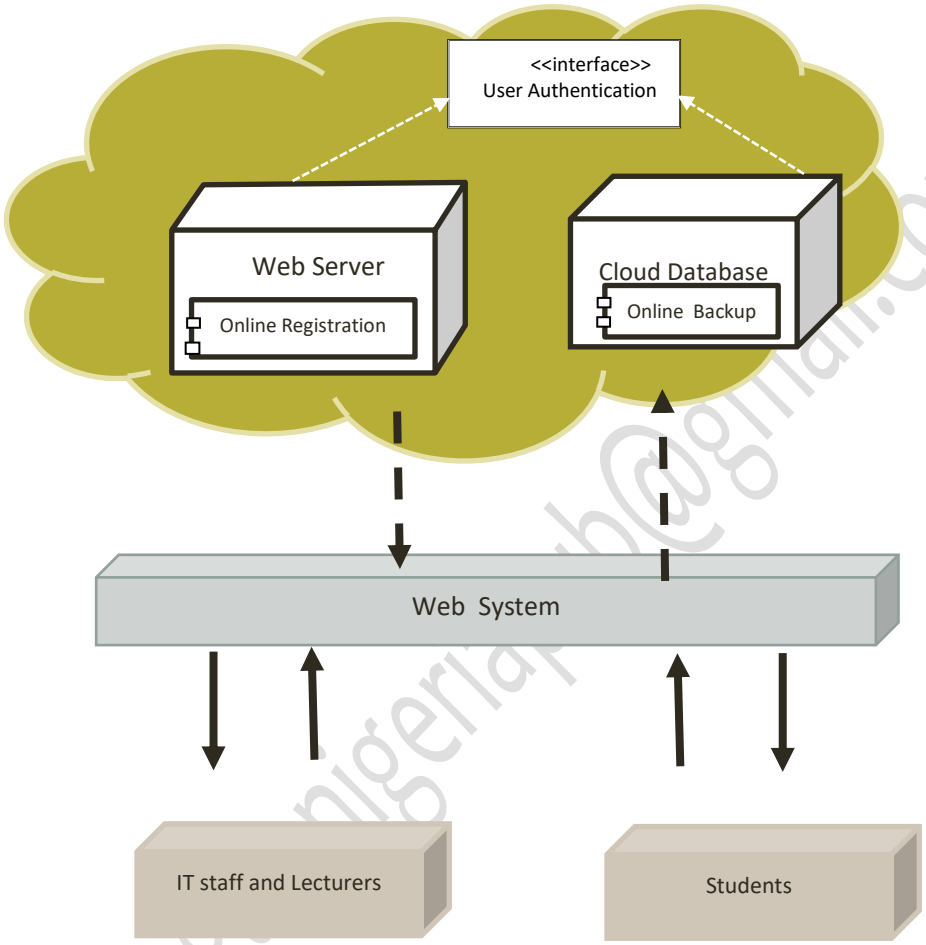

Figure 5: Deployment Diagram

Conclusions and Recommendation

In conclusion, the adoption of cloud computing technology is very essential if the institutions should move forward in the face of dwindling financial resources. Education managers should consider the return on investment which is very low and realising that the risks involved in the investment had been taken over and managed by the service providers.

The flexible terms of payment is also an opportunity for the education managers to conserve costs while the costs of maintaining the infrastructure, paying the IT consultants and vendors for upgrades have been removed. They

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can also minimize downtime occurring from incident of natural disasters, and they can as well, quickly recover from such disasters.

The learning culture of the learners is also changing from the traditional classroom system to the mobile learning system. Today's learner wants to receive instructional contents anywhere and anytime using any mobile device he is capable of acquiring (Ajuwon,2014). Cloud computing is a technology that readily supports the new culture and the learners can easily exploit these benefits.

The benefits of cloud computing technology is immense and its adoption is highly recommended for any new and existing publicly or privately funded educational institutions.

REFERENCES

Ajuwon A. A. and Oladele R.O. (2016), Cloud Model Construct For Transaction-Based Cooperative Systems, *Journal of Computer science and its applications,* 14 (1).

Ajuwon, A. A. (2014), Using mobile telephony as alternative mode of presenting instructional contents. *The Erudite,* 2(1), p.1-18.

Arora R. and Parashar A.(2013), Secure User Data in Cloud Computing Using Encryption Algorithms *International Journal of Engineering Research and Applications (IJERA)* 3(4), p.1922-1926.

Atayero A.A. and Faseyitan O. (2011), Security Issues in Cloud Computing: The Potentials of Homomorphic Encryption, *Journal of Emerging Trends in Computing and Information Sciences,* 2(10).

Buyya, R., C.S. Yeo, S. Venugopal, J. Broberg, and I. Brandic (2009), Cloud Computing and Emerging IT Platforms: Vision, Hype, and Reality for Delivering Computing as the 5th Utility, *Future Generation Computer Systems* (25)6, p.599–616.

Mell P. and Grance T. (2011), The NIST Definition of Cloud Computing: Recommendations of the National Institute of Standards and Technology, *NIST Special Publication sp 800-145* http://csrc.nist.gov/groups/SNS/cloud-computing/, Retrieved on 30/04/2019.

Yamin F.M., Ishak W.H.W., and Ibrahim A. (2014), Students Acceptance on Document Sharing through Learning Management System. *Proceedings*

of 6th International Conference on Education and Information Management (ICEIM).

Vouk, M.A. (2008), Cloud Computing—Issues,Research and Implementations, *Journal of Computing andInformation Technology* (4), p.235–246.

Wikipedia (2017), Cloud Computing, https://en.wikipedia.org/wiki/Cloud_computing/Retrievedon30/04/2019.