

A Cloud Virtual Computing Laboratory for Online Learning in Universities

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Abstract— The efficiency of employing cloud computing in the educational sectors has been distinguished in the most developed countries. It's playing important roles not only from an academic concepts but also on decrease of cost, flexibility, privacy and accessibility. This paper presents a cloud computing lab and how it is useful for student's flexibility in accessing the lab resources from outside the university at any time. Virtualization technology through virtual computing lab-VCL is conducted in Bayan University, to give the students an open, flexible environment and to overcome the problems of adding a new extended physical computer which made by an internet connection. This flexibility of cloud computing provides them the ability to continue to work on their homework and projects outside the lab hours as well as at their convenience, preference and choice.

Index Terms— cloud computing, higher education technology, virtual machine, virtual computing lab.

1 INTRODUCTION

THE success of every tertiary institution in the 21st century will to a large extent rely on effective utilization of various forms of communications resources and information systems. Understanding of Information Communication Technology (ICT) is therefore essential to meeting up the changing world. In the present information age, information and communications technology (ICT) plays a vital role in transforming the manner in which knowledge and skills are transferred to learners from traditional face-to-face approach, partly as a result of the increasing number of students seeking a place in one of the various departments in universities and other tertiary institutions [1][2].

Cloud computing plays important role in education sector especially at higher education. The most characteristics of cloud computing in universities it's cost effective, quickly access to information and free solution of maintenance that in turn will refinement communication and cooperation [3]. When cloud computing discover it's support new technical to establish a unified , also it provides flexibly and open network platform technology and decrease the physical input .Internet is the resource where we can transform cloud computing, it can deliver the most advanced software and educational materials, hardware resources and services to students and educators [2].

From October 2007, IBM and Google announced cooperation in the cloud computing domain it's become more "popular". Blue Cloud was knowing from IBM and understandable in August 24, 2006 that would become famous of Cloud Computing. Elastic Computing Cloud (EC2) public has go down as a test version from Amazon which made the IT resource more flexible [4]. Whenever made compression in the application of ICT, cloud computing has many advantages such as reduced upfront investment (i.e., software, hardware, and professional staff to maintain servers and upgrade software), reduced launching time, where days become hours ,expected performance, high availability, infinite scalability, tremendous fault-

tolerance capability, and enhanced collaboration, accessibility, and mobility, allowing users to use any device, such as a personal computer (PC), or a mobile phone, etc.

There are two key educational technologies that are increasingly used for teaching and fundamentally changing how training is delivered. On one hand, online learning systems, on the other hand, virtual machine technologies (e.g., VMware, VirtualBox) are more and more used by educators from different disciplines to create self-contained and portable virtual educational appliances [5].

Virtualization technique has capability to run single or multiple operating systems in a single PC or VM. So user could run numbers of application in the same or different operating systems on a single PC or server. This is better than from using separate machine. It's very common that software for some course that was studied in universities only need a small portion of the departmental computers. Installing everything on the same system will also lead to deteriorated performance and potential software conflicts. So, Virtual Machine (VM) is a very promising solution to the above issues. Educational software can be conveniently packaged in their virtual machines (VMs) and transparently distributed and deployed to any computer.

Virtual Computing Lab (VCL) is belong to the platform in cloud computing which as open source and free with elementary goal of delivering devote, usage computing environment [6][7]. There are a lot off important research effort that conserate to employ cloud computing in education sector [5].

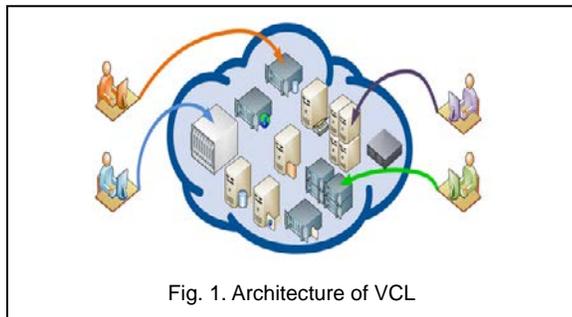


Fig. 1. Architecture of VCL

Based on the above considerations, we have deployed our cloud based virtual lab using VCL, as shown in Fig. 2. The cloud in the middle represents online learning web site "Microsoft Azure", or our VCL-BU (Bayan University) cloud service in the core. Inside this cloud, the different ellipses signify various VM images that can be instantiated for teaching purposes.

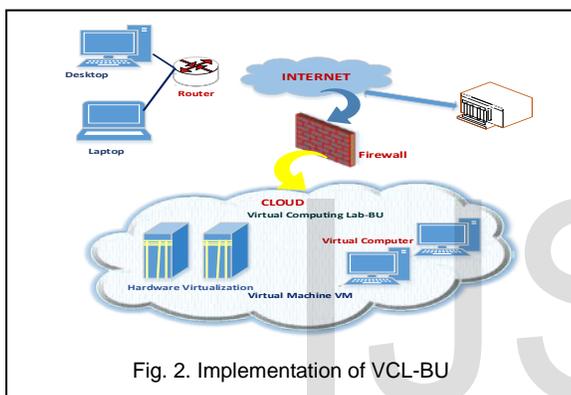


Fig. 2. Implementation of VCL-BU

This paper is organized as the following. Section 2 provides information of cloud computing likes deployment models, characteristics, services. Section 3 shows the main impact of cloud computing in education sector. Section 4 presents the design and implementation of VCL-BU. Section 5 describes the experiences of employing VCL-BU to teach real course. Section 6 concludes the significant impact of cloud computing in educational and the role of VCL in Universities.

2 CLOUD COMPUTING BACKGROUND

Cloud computing comes in many shapes and presents offers for multi of virtual hardware resources such as, servers, networks, storage or virtual software resources(application, development of platform, and services). The computing capabilities of cloud computing resources can be rapidly provisioned and released with considering to demand. However, the name of cloud computing comes from use symbol of cloud shape as an abstraction which contains the complex infrastructure for whole system diagrams. Generally, cloud computing services can be organized mainly to the three types [2] [8] [9]:

2.1 Cloud Computing Service Model

There are three levels of services are supplied to cloud customers as shown in Fig. 3. The different types of cloud computing services commonly referred to as Software as a Service

(SaaS), Platform as a Service (PaaS) and Infrastructure as a Service (IaaS).

- Software as a service (SaaS): is a software distribution model which offered as services on the Internet and makes software applications available to customers rather than as software packages to be purchased by individual customers. Its' eliminate the need for organizations to setup and run applications on computers or on data center. This type of service is running on the provider's infrastructures and is accessed through client's browser (e.g. Google Apps and Salesforce.com).
- Platform as a Service (PaaS): In this type of cloud computing, the applications are delivering over internet. Since a cloud provider supports a customer hardware and software tools to use their as a services platform for IT solution. Users only need to log in and start using the platform that ordinary allows customers to frequently change or upgrade operating systems features from the provider's cloud infrastructure.
- Infrastructure as a Service (IaaS): the components of computer resources are available as services to customers. This resources such as storage, CPU and memory. This form of cloud service has advantage especially in cost compare with traditional techniques which eliminates the capital expense of deploying in-workloads hardware and software. As examples in this service, Go Grid, Flexi scale, Amazon Web Services (AWS), Windows Azure, IBM Smart Cloud Enterprise, Google Compute Engine, and Rackspace Open Cloud.

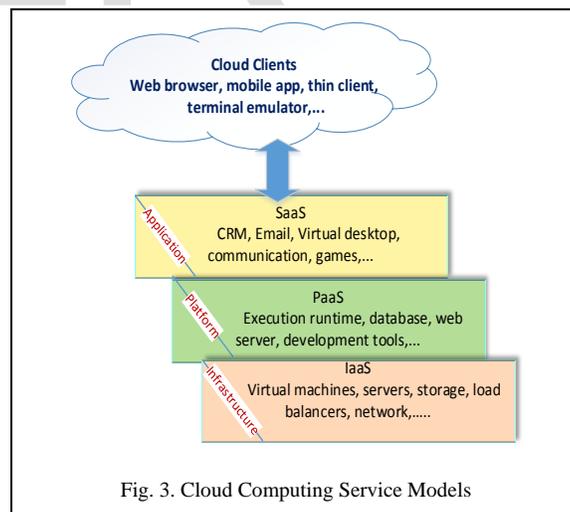


Fig. 3. Cloud Computing Service Models

2.2 Cloud Deployment Models

There are different models of deployment which differently in distribution and physical location. This deployment models have been adopted by the cloud computing and could be organized as four types [2] [10] [11].
Public cloud: it's a deployment model of cloud computing where infrastructure could be available to the general public

over the internet. It's also describing cloud computing in the traditional mainstream sense. The main benefits of this types constrained on inexpensive and easy to use where the hardware, the applications costs would be supported by the provider. Beside that no wasted resources, we paid for what we used

A private cloud: it's a type of cloud computing that is dedicated to a single organization. It has similar advantages to public cloud such as self-service and scalability within specific architecture. Unlike of public cloud, it's best for businesses with dynamic unpredictable computing needs, mission-critical workloads and security concern. While businesses assign a portion of existent data center as a private cloud and just only pay for the resources they use.

A community cloud is a multi-lessee infrastructure which is shared through several organizations from allocated group with joint computing interesting. The main benefit of this type is to have participating organization that related to public but with added level of associated with private cloud.

Hybrid cloud uses a mix of on-structure, private cloud and public cloud services with synchronize between two platforms. It gives businesses more data deployment options and flexibility. For Example a project can deploy an on-structure private to host critical workload but with public cloud provider

2.3 Security in Cloud

Cloud computing security is the set of processes, policies, and control based technologies that designed to involve the confirmation of information security, data applications and infrastructure associated with cloud computing use [11]. It plays important role in all different types of service models (software, platform and infrastructure) with organizes the way of delivering theses services through public, private or hybrid delivery model.

3 CLOUD COMPUTING BASED EDUCATION LEARNING

Educational cloud computing is considering one of the most application that become famous in the last year of this century. Indeed, cloud computing would enable an educational institution to actually employ of the global internet resources for data storage and data analysis. Furthermore, cloud computing allows all sectors of higher education to access in real time to get the information from anywhere in the world in a matter of seconds. This matter is very useful in education field, it's pretty important as it gives the teachers and the learners to constantly update their stock of information and also, they are able to access software application with other useful tools for students re leaners such as lectures, class tutorials, assignments [12]. The advantages of education system based cloud computing are [13]:

- Cost savings
- Accessibly: students can access a wider group of resources and applications software from anywhere of the world.
- Updating the application software instantly free or pay per use 24 hours.
- Openness to new technology for students: students

have able to learn things more effectively and experience.

- Green technology: protect the environment

4 VIRTUAL COMPUTING USING CLOUD COMPUTING TECHNOLOGY

The term virtualization or virtual machine (VM) came back to mid of the last century that made according to the experimental of IBM M44/44X system. A virtual machine (VM) is representing a computer software which includes the virtual hard drive, virtual memory, virtual network interface card, and so on. As any software, a virtual machine needs to run on a host computer. While running the virtual machine on the host computer, the virtual machine will use the physical memory and hard drive of the host computer

Virtualization plays important role in education, especially in computer education which increased widely. As shown in Fig. 2 the virtual lab environment offers advantages in terms of usage and availability of resources to both the students and their faculty, while offering economic benefits to the university.

A virtual lab offers numerous benefits [10] [14]:

- The virtual computer lab gives the students an open and flexible environment. Since, all applications and devices are on the cloud and under the cloud provider management; so, after each lab class, the lab administrator needs only a short time to reset the lab systems to its original status.
- A significant amount of time is saved when the students or instructors begin the request of a new application and the application is installed. An instructor can quickly install the new application needed for the course.
- Virtual labs prevent traffic jams and ease the burden of time and space. The students can access the needed software and hardware in the virtual environment; they don't have to be physically present in the lab.

There are different methods of representation VCL as following:

- Remote access to multiple single-user computer systems
- Remote access to one or more multiuser computer systems
- Remote access to multiple virtual machines hosted within one or more to a single-user computer systems

5 CASE STUDY: BAYAN VIRTUAL COMPUTING LAB (VCL-BU)

VCL-BU is a service that lets Bayan students to reserve a computer with required software and access it remotely from anywhere which have Internet checkpoint. Therefore, in the proposed way, VMs design by depending on Infrastructure as a Service (IaaS) on demand for students. These machines are customized for subject module, exercise and practical experimental of laboratory that supplied to establish virtual laboratory

More internet browser are used as the development environment likes Google App Engine, Microsoft Azure Services, Salesforce.com, Internet Application Development platform and Bungee Connect platform. In our study, Microsoft Azure Services is used as development environment as shown in Fig. 4. The windows Azure cloud Service Platform (ACSP) consist of services that lets the faculty students and teachers to build user identities, manage work flow and runs other functions.

However, ACSP includes an operating system that has database with highly relational, service bus for messaging, and a demand access controller supporting the enhanced connectivity of security [8].

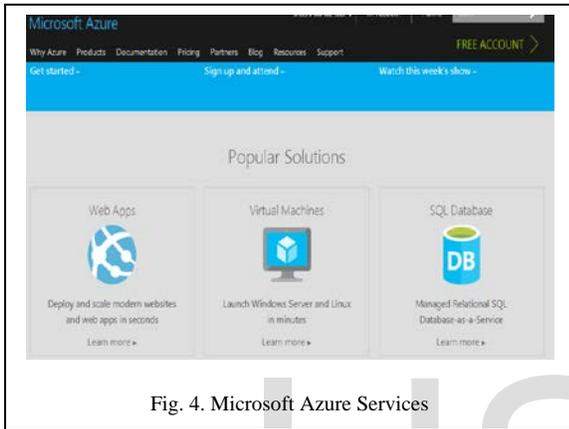


Fig. 4. Microsoft Azure Services

5.1 Installing of BCL-BU

Fig. 5 illustrates the workflow of VCL-BU which consists of five main key parts:

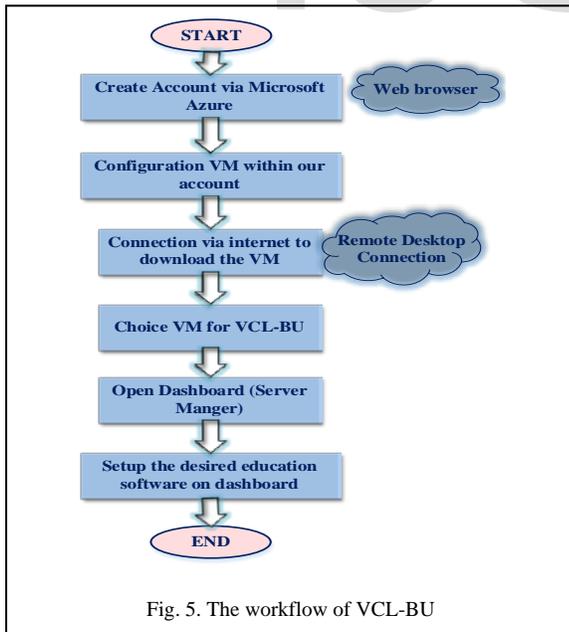


Fig. 5. The workflow of VCL-BU

1) It uses a web browser "Microsoft Azure" to create a free account. 2) It makes use of cloud computing resources to host the education VM and configured its'.3) It provide online access to the VM via Remote Desktop Connection and using a personal computer as an environment for it. 4) It uses VM as a protocol for

main project VCL-BU. 5) It provide dashboard interface as a server manger to setup the desired education software.

Following procedure can be followed to deploy this tool:

- Step 1: Create account: with the Microsoft Azure as a web browser (<https://azure.microsoft.com/en-us/>), select create a free account >> Open. Then select the virtual machine using the browse button to locate the virtual machine. See Fig. 6.
- Step 2: Initialize the VM: choose the appropriate VM >> VM supports 32-bit host operating system, supported that the following condition is met: we need a 32-bit processor with hardware virtualization support as shown in Fig. 7.

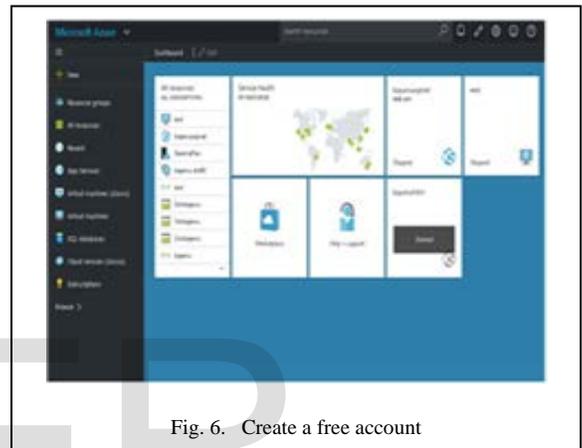


Fig. 6. Create a free account

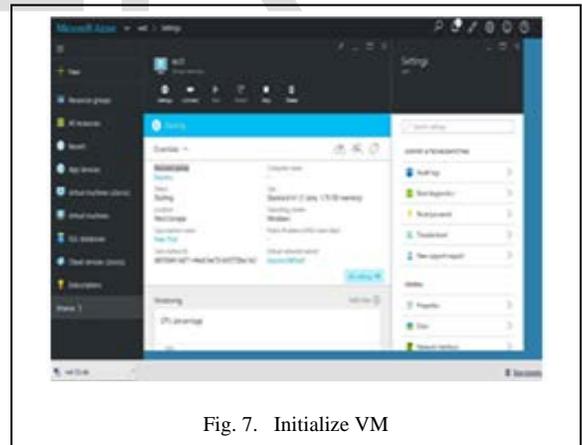


Fig. 7. Initialize VM

- Step 3: Download VM manger: make connection via Remote Desktop Connection to load the VM as shown in Fig. 8. So, your cloud virtual machine is now created and we can use the machine in any environment (PC or Laptop). It also allows to change the hardware configuration of our VM after that.

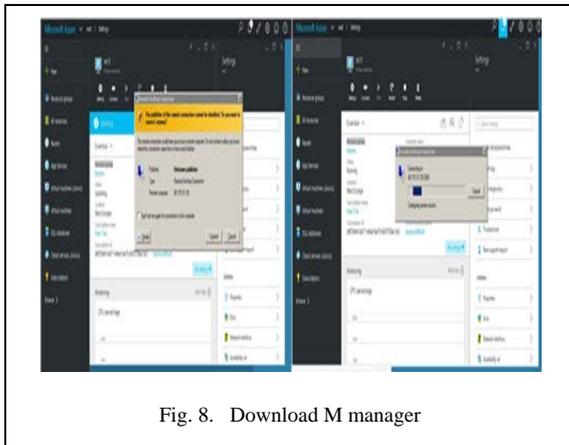


Fig. 8. Download M manager

- Step 4: Dash Board Screen: Now, screen of dashboard opens as a server manger through our account as shown in Fig. 9, and prepare storage the desired educational software programs on the VCL-BU.

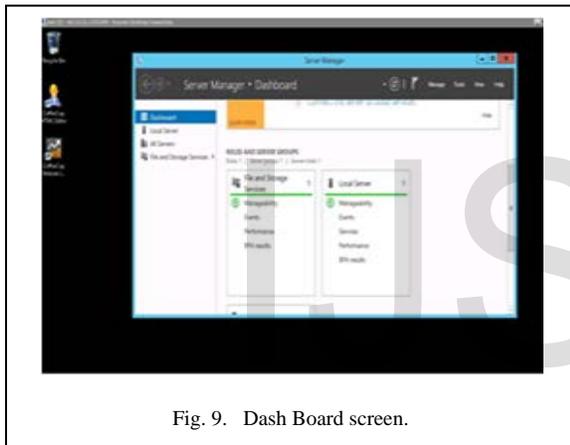


Fig. 9. Dash Board screen.

- Step 5: Begin using the VCL-BU: we should be able to access a running our academic software program at this state as example here "Coffee Cup HTML Editor". Teachers can assessment and debuging student's exercises. And also, students run their courses software from anywhere using own account. Above Fig. 10 describe the running of educational software via VCL-BU.

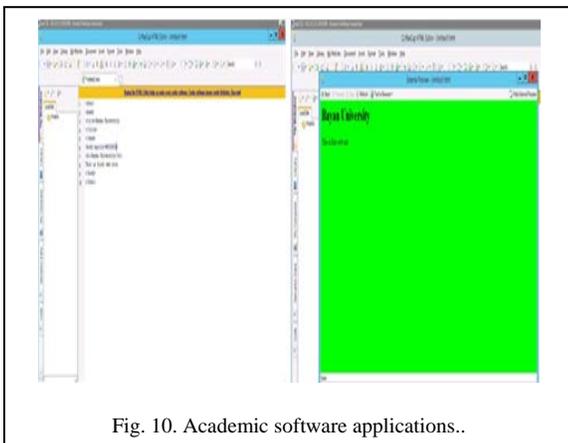


Fig. 10. Academic software applications..

6 CONCLUSION

Fortunately, cloud computing plays important role on education sectors. Availability of the cloud in education, the learning in universities become less expensive, free solution of maintenance, highly portable and which in turn will improve communication and collaboration. While, the cloud computing based education get permission us to access our tasks anytime, anywhere under supervision of the teacher. As a result, this paper provides some background information on cloud computing, characteristics, services and deployment models. In addition the cloud education system through virtualization technology is introduced in this paper. The role of virtualization or virtual machine (VMs) in education, especially in the field of computer education, is highly increasing. Educational software can be conveniently packaged in their virtual machines (VMs) and transparently distributed and deployed to any computer. So, the goal of this paper is described the concept of VCL, conducted in Bayan University, to gives the students an open and flexible environment and to facilitate increasing of the components computer labs by supported all required application using an internet connection.

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