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Single Process Architecture for E-Learning Over Cloud Computing

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Abstract - A Cloud is a type of parallel and distributed system consisting of a collection of interconnected and virtualized computers that are dynamically provisioned and presented as one or more unified computing resources based on service-level agreements established through negotiation between the service provider and consumers.

Cloud Computing refers to both the applications delivered as services over the Internet and the hardware and systems software in the data centres that provide those services (Software as a Service - SaaS). The data center hardware and software is what we will call a Cloud.

From the studies of various research papers and works done by various researchers it has been found that the major areas of focus in the field of cloud computing are architecture definitions, security, integration of services on various layers, inclusion of Various network and communication devices being developed rapidly.

E-Learning through cloud computing is a promising area for the ease of both faculties and students around the world. The work done in cloud computing based e-Learning is oriented on centralized server and further improvement in this can be done.

In this research, a new distributed architecture is being proposed to provide an opportunity to the learners around the world to use the resources being shared by the faculties and online communication between the faculties and students.

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GJCST-B Classification : *C.1.4*

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Gunjita Shrivastava [α] & Sandeep Sahu [σ]

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I. Introduction

Growth of cloud computing is very fast as it is being accepted by persons in spite of its security issues. The problems have been overcome by the latest techniques of security available for the networks. The advantages of the cloud are also making it popular among the people and companies. The clients of the cloud are on whole of the Internet including web space hosting providers, data centres and to virtualization software providers. Since cloud is a new not very clear term and its fuzzy nature is causing researchers to define cloud according to their own thoughts for the cloud.

Companies which have accepted cloud and implemented it and the various researchers have defined the cloud in their own terms. Some companies which are working on cloud, Google, Apple, IBM, Microsoft and Yahoo and others are providing high quality cloud computing services. The cloud solutions provided by these actively sponsor research centres, pursuing development of marketable technology.

The architectures of the cloud provided by these companies are having various layers of processing and the major layers in cloud architectures address the different parts of the cloud applications. The cloud includes various PCs, hand held devices for connectivity to the cloud with Internet, servers processing client requests and provide services to the various connected devices from the cloud, the software tools related to the several cloud applications such as database management systems, hardware resources, virtualization applications etc. Also a data center and broker applications are used for providing the authentication, authorization, confidentiality and sharing of resources for the users of the cloud. These different parts make the complete cloud and can support other cloud oriented devices as well.

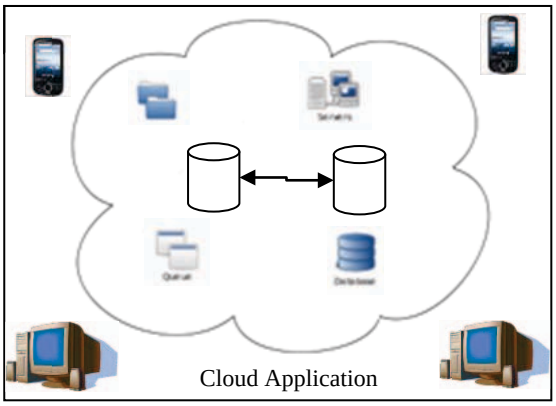

Figure 1 : Cloud Computing

According to the usage, cloud has various types i.e. public, private or hybrid clouds. Public clouds are provided to public users using pay-per-use manner. Services being provided using Public Cloud are called Utility Computing. Similarly when the services are provided for particular organizations then the cloud is known as Private cloud. Private clouds will provide all their services according to the requirements of a specific organization. Examples of the user oriented applications such as shopping carts, banking services etc requires both behaviors of Public and Private Clouds, such clouds serve both the type of users and hence it is known as Hybrid Clouds.

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To achieve knowledge based economy, education is to be affordable and able to reach the mass at an affordable cost. The traditional class room alone is not sufficient to reach the mass population. An E-learning platform based on open standards with minimum initial cost of investment, will be able to scale dynamically based on the demand, capable to collaborate with other enterprise applications, personalization options as per the student requirements, and low maintenance cost can drive the adoption by educational institutions.

Adoption of cloud computing can help, educational institutions to reduce expenditure on infrastructure, software and human resources to a considerable extent. Institutions can rent the services as and when needed. They have the flexibility to mix and match based on the best service available in the market. Cloud computing is based on open standards. The interoperability of applications is dynamic and the resources can be provided based on the demand and usage of the applications. Cloud computing integrates silos of applications in distributed environment. This in turn gives rise to rich and valuable content to meet the needs of teaching, research and student requirements.

Learning through electronic devices, accessing the courseware on line through the Internet is known as e-learning [1]. E-learning platform, electronic learning, virtual learning environment (VLE) and learning management system (LMS) are some of the acronyms meaning the platform providing e-learning capability [2]. In the recent years there is an increase in the usage of electronic devices to access e-learning content due to:

1. Increase in broadband width, affordable cost of computer or hand held devices.
2. Due to low enrolment and budget cuts, educational institutions, like universities and TAFE colleges are offering some of their courses on-line.
3. The aging population's educational needs, to access materials anytime anywhere has also fuelled the growth of e-learning.
4. The recognition of online educational degrees offered by institutions has a great impetus on foreign nationals taking up such courses.

The traditional model of education is class room based or instructor led training. The new paradigm is on-line distance education. Web 2.0 technologies make the delivery of education contents more interactive and encourage students to learn. The e-learning systems customize the course content based on the user's ability [1]. The personalization of the courseware makes it easier and encourages the users to learn at their own pace, giving more flexibility in learning.

E-learning can be delivered by different models based on the bandwidth and the devices used to access by the students.

Tele-immersion environment model uses the video avatar and virtual board [1]. This gives students the feeling of a class room environment, stimulating face to face class room experience. With the 3D enabled video broadcasting, Teleimmersion will be widely accepted by students. The drawback is the initial cost of investment of high resolution video recording devices. A high band width is also necessary to transfer the data and users accessing devices must have high resolution video card and system configuration.

Prior to the inception of web 2 technology, courses were designed for the users to access with low bandwidth networks. Users did not require high end computers to access the content.

Though the personalization option was available, the courseware did not consist of high resolution graphics and video contents.

Hybrid Instructional Model is the blend of the traditional class room and e-learning. Users still need to attend the class and be able to access the course ware through e-learning. This combination makes the best use of both and helps the students to shift from class room training to e-learning mode. Students are able to adapt to this hybrid model as there is a smooth transition. The courseware can be of power point class presentation, reference books, student blogs, 3D based, avatars etc. Hybrid model e-learning platforms can be Web 2.0 based depending on the band width available and the devices used.

II. Architecture of Cloud Computing

a) *Cloud Concepts*

Cloud computing is the utilisation of vacant resources of computer to increase the efficiency through improving utilization rate and reduce energy consumption, one of the solution to reduce green house effect [7]. Cloud computing, is an evolution from Application Service Providers (ASP) [3]. It is based on Service Oriented Architecture (SOA), where the software applications can be dynamically configured to utilize the best breed of application in the market place. Cloud underpinning technologies are virtualization, Software as a Service (SaaS) [4, 3, 8, 6] and broadband width or 3G mobile networks.

b) *Cloud Advantages*

Cloud computing, due to its low or almost zero capital expenditure (CAPEX) cost and low operating expenses (OPEX) has triggered new enterprise applications affordable to educational institutions with low budget [2,3]. A particular university decommissioning hosted email service and moving to vendor supported infrastructure saved $ 4,50,000 per year [5]. Cloud computing due to its open standard provides interoperability with other institutions enabling collaboration of content thereby producing rich content for educational institutions across the world [3,2].

c) Cloud Issues

An organisation moving into cloud space must not depend on services provided by one vendor [5]. Institutions must mitigate the risk with the combination of few cloud providers as it will help, even if one cloud company goes down or become bankrupt.

Service level agreements (SLA) are not well defined in cloud business model. Cloud model is based on dynamic configuration, but the SLA is still applicable for static deployment model [6]. Quality of Service (QoS) is dependent on the SLA. QoS is to be well defined to ensure application usability, availability and experience of the users.

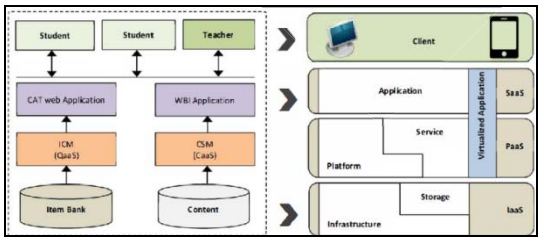
III. Existing System

According to Manop Phankokkruad, 2012 [1] has addressed the problem of the cloud computing as, the classical e-learning system is based on client/server architecture thus they lack of the scalability, flexibility and interoperability. It makes the learning resources cannot share, and the system improvement is not easily.

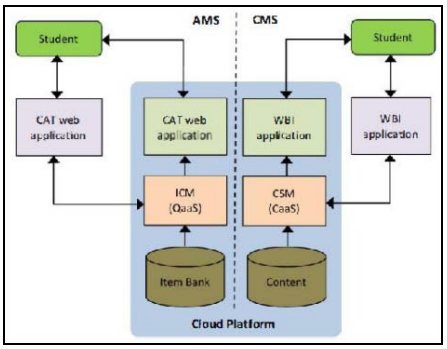
In their paper [1], authors have proposed a new architecture for e-learning system that the architecture separate into three layers includes infrastructure, platform and application.

On Infrastructure layer, the learning resources from the traditional system are transferred to the cloud database instead of the usual DBMS. Whereas on Platform layer, a new e-learning system that consists of the CMS, AMS, and other service components were developed. These components were developed to be the intermediary between cloud database and the applications. [1]

Finally on application layer, CAT web application and WBI application were developed for interacting with the student's client. [1]



Cloud Service Architecture for e-Learning System



The Implementation Components of the Cloud on E-Learning System [1]

Mingwei Wang, Jingtao Zhoul, Shikai Jing et. Al. 2012 [2] have specified in their work that the proposed systems must be self adaptive and should provide the flexibility to the clients as per their requirements. The cloud manufacturing vision (GetCM) is introduced to provide the on demand architecture with reliability, flexibility and reliability based on cloud computing. In contrast to the conventional networked manufacturing paradigm, the paper analyzes from technological, functional and economic aspects to provide the evidences of the benefits from GetCM.

Focuses of this paper are placed on the vision and the outline of GetCM architecture.

Yangpeng Zhu, Jing Zhang, 2012 [3] have focused in their research over SaaS layer and specified that software as a Service is becoming a popular research field in software development for its feature of low costing entry, easy implementation and zero infrastructures.

With the extensive development of SaaS software, how to create a safe, stable, user-configurable, high performance, low cost SaaS development model has become a key issue. As the structures of various Cloud computing platform and the increasing number of tenants[6], combination SaaS system and the cloud platform can reduce operational costs, provide more and more flexibility and scalability.

IV. Proposed Algorithm

Cloud computing is making users convenient around the world using its services which are available around the world directly on their machines over the web. Cloud computing is good for both the service providers (they get huge customer base) and clients (they get all services at their doors).

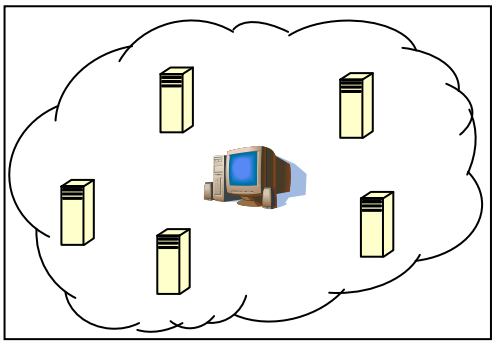


Figure 3 : Simple Cloud

Service of E-Learning is one service which is required for all the students around the world to avail the best faculties around the world teach them with their high skills.

In this paper, a new distributed architecture is being proposed to provide an opportunity to the learners around the world to use the resources being shared by the faculties and online communication between the faculties and students.

Studies of the researches reveal that the cloud computing is enhancing rapidly and various architectures for cloud oriented processing are being proposed specifically such as e-Learning, Manufacturing, Multi Tenant Architecture etc.

In e-Learning, has proposed an architecture which is centralized server database oriented architecture. In this research, emphasis is on SaaS development for providing a cloud solution for e-Learning, which is the area where no other researchers have been proposed earlier. [1]

For e-Learning on Cloud, we need to implement Cloud Application which shall be working on SaaS Layer. Proposed application will be developed in following steps:

Step 1: There are two users, one working as teacher (admin) and other as student (learners).
Step 2: Online text whiteboard and examination system shall be used for presenting the working of the proposed algorithm.
Step 3: There will be two or more servers which will share the information from each other. (Cloud)
Step 4: Teacher can add from any server and students can learn from any server to show the mapping of the clouds.

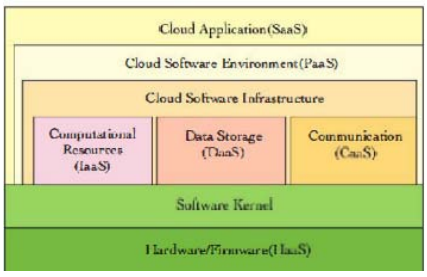


Figure 4 : Cloud Computing Logical Diagram

Step 5: DBaaS (Database as a Service) is also implemented which provides mechanism for data interaction for SaaS layer and manages data using Distributed database management system (DDBMS) so that speed of processing shall always be up to the mark.
Step 6: The overall system architecture defined in this paper is straight forward and allows for simplicity of processing for the users of the clouds.

The two major services being offered as on the proposed architecture are white board and online examination system. Whiteboard is a utility services for the faculties to teach using text, images and other multimedia services available online and in this proposed work it is being implemented using AJAX based chatting service which will allow the faculties to send files over the cloud for all the students who have joined the online class room.

Online examination system is a evaluation system which will be implemented for evaluating the skills of the students who are undergoing the course. It will include objective type questions for evaluation. A common home page shall be there to show the current toppers of the examinations conducted for the students of the system.

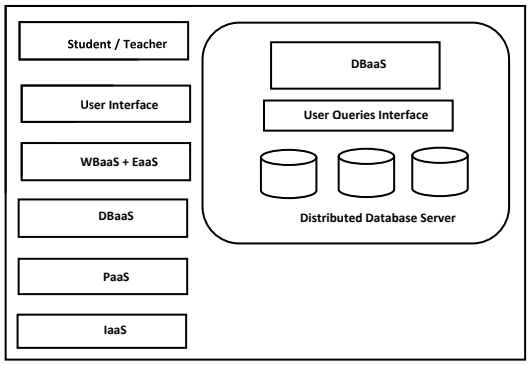


Figure 5 : Proposed Cloud Architecture

V. Results & Discussion

The proposed work has been implemented using C# and SQL Server Database. The work involves two clouds having proposed work applied for sharing of data between then.

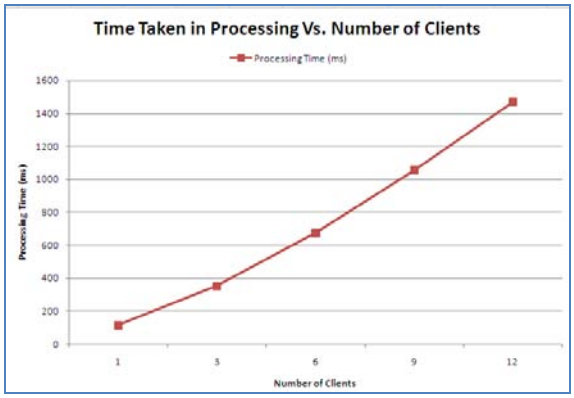


Figure 6 : Time taken in processing vs. number of clients using proposed e-learning architecture

From the graph it is clear that as the load is increased with the clients then the proposed system works smoothly and the time requirement increase gradually with the number of clients. The increase in number of clients does not overload the proposed architecture and hence it is concluded to be upto the mark.

From the above graph resource utilization of the proposed work is shown to be increasing with the number of clients and hence it is as per the expected results.

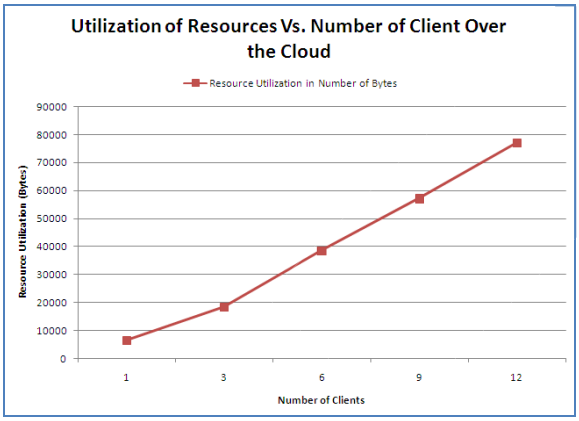


Figure 7 : Resource Utilization for number of clients using proposed e-learning architecture

VI. Conclusion

Studies of the various papers and works done by authors have been done to find out the problem and it is found that the cloud computing is apparently a new technology which is growing very fast and provides new horizons to the computing world. It is technique where implementations are not too many and the major players in industry are very few. The situation is so because a lot of structural, architectural and security work in various applications of the cloud is still to be done. This work selects a similar problem of E-Learning through cloud computing and proposes a new architecture for the same.

E-Learning has been taken as the application area to showcase the working of proposed cloud architecture. Several application areas have been found and it is concluded that e-Learning is the emerging field in which lot of work has not been done for the security of the contents and users.

Various papers and researches in the area have been studied to find that other algorithms in this application area are focused on to provide the contents to the clients.

VII. Future Work

The proposed work is being implemented on simulation environment using standard machines, in future the same can be deployed over the real cloud environment and test it for its accuracy and performance.

A further improvement in the architecture at IaaS and PaaS layers may be helpful in increasing the performance of the e-Learning system.

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