A Distributed Learning & Teaching Environment across Institutions based on Advanced Grid Portal Technology

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Abstract

This study presents web-based networked information and collaborative authoring architecture as Information and Knowledge Grids. This architecture is made possible by advanced open source grid portal software in conjunction with distributed parallel computing system. Using this advanced grid portal technology all the cluster servers of different institutions has been developed that configure themselves as a learning & teaching Grid environment. The distributed learning and teaching grid environment supports multiple independent course specific collaborative content, information and knowledge networks across distributed servers over the Internet and parallel computing system enhances the job performances. These are in the process of getting deployed in the inter-campus departments in University Technology Malaysia (UTM) for improving the quality of higher education as an initial stage. This Grid architecture provides reasonable and effective online assisted learning environment for the institutions in any subject. The paper describes in some details of the architecture of advanced grid portal based on parallel computing system, learning & teaching interactions and the processes of courses management over it.

Keywords: grid portal, collaborative authoring, parallel computing system, web-based learning.

1. Introduction

The conventional Web Based Education (WBE) based on one server which is as a result, very slow for the operation of searching, uploading, visualizing output and numerical computational. Whether Grid portal technology with parallel computing platform in supporting WBE is very high speedup in terms of searching, editing and sharing, supporting the huge memory, high quality of visualization and increasing the computational performance.

Several kinds of approaches have proposed [8] [9] [10] by various researchers for authoring activities environments. Among them Begona et al. [1] have described KADDET which is a cognitive diagnostic environment designed to assess the conceptual and procedural learning activities of students.

To fulfill graduation requirements, it is common practice in the Malaysian universities that majoring in Mathematics are required to work on a two semesters' project during their final year. By involving in the research projects, the students are trained on how to learn about a new math topic or to study more in-depth a topic that they are already familiar. Web based Education through grid portal technology is becoming a major recent trend [7]. The computational platform is supported by a low cost shared and distributed memory in solving the grand challenge applications. Individual work is essential in any learning course but, student should learn the collaborative behavior as well. Student contributions are important in group efforts. Group work on designing and authoring a courseware is not a simple task. One of the major problems in work group is unequal distribution of task (among student in a group) and compensation (performance evaluation in the form of grades). The WBE in parallel computing are designed to provide students an efficient authoring environment to overcome the unequal distribution of tasks and performance evaluations in group efforts. That means they will have the opportunity to searching, uploading, visualizing output and file saving by the help of online collaborative efforts through grid portal technology.

In the paper a sample module of graphics, animation, audio and video technology courses have been presented in this section. In section 2, we have illustrated the development and the implementation of Grid portal and web service technology to students. In section 3, web service paradigm as well as the data and analysis methods, findings as well as qualitative observations in section 4 and discussion in section 5. Section 6 will conclude the paper.

1.1 Graphics, animation, audio and video technology Course

This course provides exposure to the theory and basic concept audio, video, graphics and animation digital to student. Students shall be exposed with key concepts each stated element and how to use properly in the development of an application of multimedia and website. Students will be led to use variety of techniques procedure, element and the quality of multimedia by using software audio, video, graphics and animation. Emphasis would be also given to the aspects intermingle among element in multimedia produce education and learning material effective and having quality.

LEARNING OUTCOME: At the end education, students wish can afford:

° State basic concept relating with key elements multimedia.
° Use effectively multimedia technology relating with education and learning.
° Use technology multimedia digital to increase the quality professional jobs especially contribute to education sector. For a 14 week/semester, the subject covered on the topics stated in Table 1.

Table 1: Subjects of a semester of 14 weeks for Graduate Students

Week	Learning Activities	Remark
1	Introduction To Course, Assignment And Students Responsibility Introduction Into Multimedia • Key Elements Multimedia • Technological Development Multimedia • Development Factors Multimedia	Information about method course management, presence policy and each student responsibility.
	Introduction To Graphics Technology • Graphics Interest In Education • Role of Graphics Digital In The Application Multimedia Or Web Development Technology Digital Graphics: Technical Aspect Category Digital Graphic: Bitmap And Vector	Student must form project team for graphics assignment and animation (not exceeding 3 people for one group) Demonstration and practical training in the laboratory graphics software use (Adobe Photoshop) – Activity 1 (Photoshop)
2	Digital Graphics Technology: Technical Aspect • Digital Graphic File Format • Digital Graphics Quality: Resolution And Color Depth • Image Size And File Size	Cooperative learning activity and PBL: Digital Graphics Quality
	Introduction To Animation Technology • brief Animation Technology • multifaceted Animation Use Life • Animation Interest In Education Animation Technology Digital: Technical Aspect • Traditional vs Digital animation • Animation Production Basis Techniques	
	Teknologi Animasi Digital: Aspek Teknikal (samb.) • Konsep Asas Animasi Digital • Teknik-teknik Penghasilan Animasi Digital • Kategori-kategori Animasi Digital • Format Fail Animasi Digital	Aktiviti pembelajaran koperatif dan PBL: Konsep Asas Animasi Digital Ujian: Meliputi tajuk Grafik sahaja (15 markah)
	Perisian dan Perkakasan Animasi • Perisian Animasi: 2D, 3D dan Kesan Khas • Perkakasan: Tablet Pendigital, Pengimbas 3D dan sebagainya.	Panduan menghasilkan beberapa jenis animasi yang utama seperti motion tweening, shape tweening, frame by frame dan lain-lain.

Perte muan	Aktiviti Pembelajaran	Catatan
5	Teknologi Animasi Digital: Animasi 3D dan Kesan Khas • Pengenalan Animasi 3D • Proses Menghasilkan Animasi 3D • Kesan Khas : Morphing, Warping, Virtual Reality	Tarikh akhir menghantar tugasan 1a (5 markah)
	Latihan amali di makmal penggunaan perisian grafik dan animasi (Adobe Phostoshop dan Macromedia Flash)	
6	Pengenalan kepada Audio • Konsep Asas Audio • Penggunaan Audio dalam Aplikasi Multimedia Pendidikan • Pengenalan kepada Audio Analog dan Audio Digital	
	Prinsip-prinsip Asas Audio Digital • *Proses Pensampelan: Audio Analog kepada Digital* • Faktor-faktor yang Mempengaruhi Kualiti Audio Digital • Saiz Fail Audio Digital	
	Audio Digital Lanjutan • Pelbagai Teknik Pemadatan Audio • Jenis dan Format Fail Audio Digital • Perisian Audio Digital dan Penggunaannya	Demonstrasi penggunaan beberapa perisian audio digital.
7	Pengenalan kepada Video • Penggunaan Video dalam Aplikasi Multimedia Pendidikan • Prinsip Asas Video • Pengenalan kepada Video Analog • Format Fail dan Piawaian Video Analog Pengenalan kepada Video Digital • Proses Pendigitalan Video • Perkakasan untuk Proses Pendigitalan Video • Kelebihan dan Kelemahan Video Digital	Kuiz : Meliputi tajuk Audio sahaja (5 markah)
	Penyuntingan Video Digital • Teknik-teknik penyuntingan video • Perisian-perisian penyuntingan video digital	Demonstrasi penggunaan perisian penyuntingan video digital
	Penentuan Saiz Fail dan Kualiti Video Digital • Faktor Penentuan Kualiti Video Digital • Faktor Penentuan Saiz Fail Video Digital Pemadatan Video Digital • Prinsip-Prinsip Pemadatan Video • Jenis dan Piawaian Pemadatan Video • Kelemahan Pemadatan Video • Format Fail Video Digital	Tarikh akhir menghantar semua tugasan

The weekly hands-on laboratory exercises provide practice on graphics, animation, audio and video technology skills and authoring, sharing and communication activities. The laboratory exercises may support the student research projects outside of class.

2. GRID PORTAL TECHNOLOGY

The proposed Grid portal is an efficient web server as well as gateway by which users may access web services, manage data and compose workflows [14]. The portal is used by the administrator to construct the service for others to use and by the users who wish to act together with the service by its automatically generated web interface. Our Grid portal technology offers a framework for supplying single-point access to Grid services, similarly a Web portal such as Yahoo or MSN comprehensive site information, indexes and web pages [5][6]. A Grid service that is accessible within the portal. A distinctive feature of our grid portal is, a user navigates to the portal page, and afterward, the portal presents the appropriate applications that the user may interact with, derived from their identity and the authorization policies [12]. Like this, a virtual organization may be formed. The Grid is a mixture of network infrastructure and software framework distributing computing services based on distributed hardware and software resources [15].

We are using Netbeans IDE platform to create web service because it provides an integrated Development Environment for Java (Desktop and Enterprise) and Service Oriented Architectures. SOA concept can build upon and evolving from older concepts of distributed computing [13] and modular programming.

For the authoring environment, we have built a web services (Fig. 2 represents the diagram) for creating, editing and sharing knowledge as called as web services portal using java native. In grid portal service, we create schema Web Service Definition Language (WSDL) using tools such as Neatbean IDE, GlassFish as web engine, C compiler and Parallel Virtual Machine (PVM). After finish, students can access web service portal from a server as called as distributed or grid Computing.
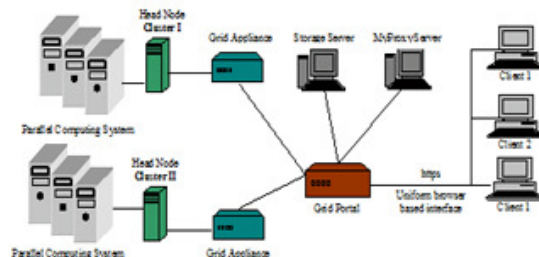

Fig. 1: Grid portal technology with parallel computing system

Grid portal supports a framework to provide a web service interface to the existing applications without having to write extra code or modify the existing web services.

2.1 Web Services Technology

Web programming is the design and construction of a program, e.g., an applet, to perform a task on a web page. In the web services development, some concept on GUIs, concurrency; event handling; graphics; network communication; and software engineering techniques and tools are exploited.

For this kind of relationship, we choose service-oriented architecture (SOA) style. Each web services are easily maintainable since there is loose coupling between interacting nodes. The development of this architecture is based on several programming language as it involves algorithm implementation on C, parallelization using Parallel Virtual Machine (PVM) and Java for web services development. The grid computing platform is an open source-based and will be develop under Linux environment. The platform development will increase the acceleration and scaled-out across a virtualized grid. The clusters of processors involved in this platform are developed on increasingly larger computational hardware with inexpensive architecture [16].

Web authoring environment Design: This document will discuss the web interface architecture and its process flow diagram. Web Architecture of Web authoring environment is shown in Fig. 2. The above figure (see Fig. 1) is the general web architecture for enabling efficient grid portal authoring environment for Internet as well as Intranet. Norma server cluster consists on n-number of servers connecting together with a central hub. One of the servers will be the master server as well as the Web server. Once the web server is running, depending on network setup, all users such as government departments, home offices and universities can access authoring web portal service [11].

The following is the list of item involved:

1) A web browser
2) Infrastructure Component (LAMP - Linux Apache MySQL PHP)
3) PHP scripting.
4) An Apache web server (free on LINUX machine)
5) PERL-CGI (A PERL script running in Apache CGI-BIN directory)
6) HTML pages (One plain HTML page – input.htm, One embedded HTML page in PERL-CGI script)
7) PVM, MPI, C programs (Sequential and Parallel architecture)
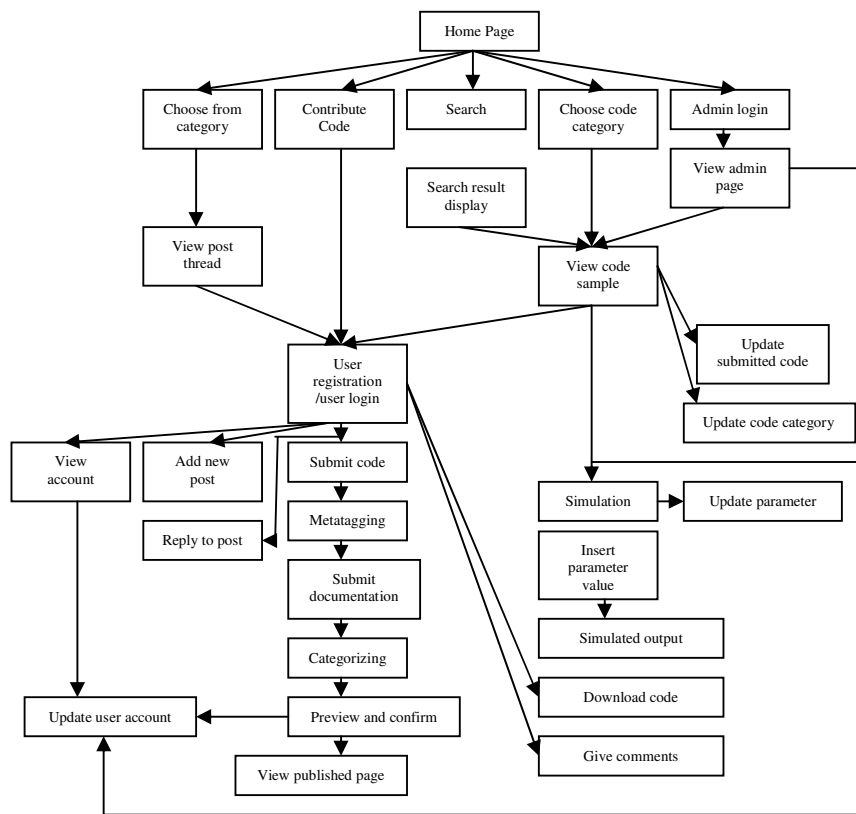8) An open source grid portal software.

Fig. 2: Overall diagram of one web service of a grid based web portal

3. WEB SERVICE PARADIGM

The web services provided the contents page which will present a synopsis of the selected subject. The user can then either follow a hypertext link to further comprehensive details. It'll provide a parallel programming exercise and the solution can be viewed after the user has completed the exercise. For the pioneer, user can retrieve a solution template. The web services covers most topics excluding domain decomposition technique, data parallelism, concurrency and domain and functional partitioning, message passing paradigm, performance measurements [4] and provide the some numerical libraries in exploiting parallelism for grand challenge applications for the authoring environment.

3.1 Authoring Method

We are defining a complete set of generic authoring tasks at all three information layers (library, subject domain and course) that are supported correspondingly by the library engine, domain engine and course engine.

There are number of composite actions such as delete all topics of a course, delete all concepts of a topic, delete all tasks of a topic, delete all concepts

of a task or give value as to all the concept weights of a task, which can be implemented with a repetitive call to the atomic operation called delete topic and list all topics and the corresponding operations for task and concepts.

The interaction process between the course assistant and course engine is triggered by a set of common authoring tasks, such as create-new-course-structure, edit-existing- course-structure, delete-existing-course structure and copy-existing-course-structure. Each of them involve set of basic course-maintenance related tasks such as add/edit/delete topic, add/edit/delete task in a existing course structure, add/edit/delete concept in an existing topic or task, link/delete document to a topic or task. They, on the other hand, trigger a set of operations performed by the course engine over the existing course structures. The operations ensure data consistency by performing domain specific checks for conflicts. For instance, when the authoring task Add (To, CS) is performed by the author the course engine performs keyword search (both in the domain and in the course ontologies) on the entered topic expression. Then, the course assistant provides the option of manual editing options over those results. Next, the course assistant presents alternative views on the course engine results: (1) textual list of results with ranking according to their relevance to the search query, (2)

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graphical representation of the course trees with the matched concepts highlighted and (3) graphical representation of the domain ontology with the matched concepts (you are here indication). Within the same step the course engine also ensures the storage of the results for further reuse. Other possible course authoring tasks relate to document library and education metadata. They comprise: (a) Link a document to a topic, (b) Link a document to a task, (c) Delete a document from a task and (d) Delete a document from a topic.

4. FINDINGS

The process of searching, saving, uploading, visualization has becomes extremely fast, reliable and precise with grid portal technology with parallel computing system. The parallel performance makes the product really attractive because of its high speed, efficient, effectiveness and high temporal performance algorithm [2] [3]. In terms of the performance of massive data execution, the result are also precise, highly convergence, stable and accurate to the exact solution.

4.1 Qualitative Observations

The process of authoring of such concept based Web courseware for group works should include domain, course, and library authoring. By supporting the authoring activities further we aim at increasing the efficiency with respect to information reuse and collaboration between the course authors.

There are three main modules in AIMS authoring environment: Domain editor, Library editor, and Course editor [3].

The *Domain editor* allows the author to perform functions, such as add, delete and update domain terms and links between them, in order to construct a domain concept map structure. The editor facilitates the full description (name, definition and classification in the concept mapping hierarchy of terms) of domain terms and the links between them. The editor also allows the author to create new types of links and to create links between a domain term and existing documents in the AIMS library.

The *Course editor* provides the author with a framework to define the structure of tasks and topics for a course.

One course can consist of several topics and each topic can have several tasks. The author constructs this structure on the basis of domain terms and direct links from them to the library documents. This way s/he ensures a link between the course structure and the appropriate course material.

The *Library editor*, as most of the library systems, enables the maintenance of information collections. In this case the Library editor provides

access to all the information and data related to different courses and domains. The novel feature here is the task- and use-oriented description of documents, by including instructional and presentation formats within the description of each document.

5. DISCUSSION

In pure collaborative authoring, each author takes over an authoring sub-task(s). When each author accomplishes the sub-task(s), the group goal is reached and collaborative mutual interdependent authoring is achieved.

In the wider spread cooperative authoring, authors just reuse each others materials, style, learning goal settings, dictionaries, linking and sequencing, etc. The primitive interaction activities among participants during both cooperative and collaborative authoring, from a macro granulation perspective, are as follows (listed in their order of priorities):

- Planning/Execution/Creation
- Coordination/Control
- Initiative/Supervision
- Observation/Suggesting
- Data/Idea sharing
- Dialogue (with Interaction)

This research will provide the following benefits to students and participating universities:

- Facilitate and support work group students in their design and developing a courseware.
- The successful application of authoring activities environment through grid technology provides enhancements in work group performance, helps to lower cost, and encourages innovation.
- Learners and faculties can promote the exchange of ideas, information, knowledge, and joint research and development of Web-based teaching materials.
- Help member universities build a network of facilitators to support e-learners (forum with advanced Information and Communication Technology (ICT), i.e., with the use of massive parallel processors of globally distributed and yet interconnected mini-supercomputers through global neural computer network).
- Researchers can partner with colleagues in more advanced faculties, and perform joint collaborative research and development with the use of the emerging global GRID computer networking technology.

6. CONCLUSION

A convenient mode of obtaining most of the intrinsic worth of Web-supported or Online Supported teaching and learning for the huge quantity of institutions that does not necessitate extremely high investments concerning the infrastructure of Internet is being applied as Grid Portal for education especially teaching and learning environment. The deployment of such a Grid portal environment is being on processed in the University Technology Malaysia. The grid portal technology with parallel computing system represents an effective upgraded approach to deploy C and JAVA programme code applications as Grid services. The more pervasive take-up of Grid technology requires high-level Grid application environments where users can easily create complex Grid workflows including different Grid enabled applications. The user only has to provide several mandatory parameters to an HTML pages in PERL-CGI Scripts based Code Interface Description File and PERL-CGI enables the code application to be run from a Grid service client. All these C and JAVA programme codes were executed from a single workflow and the execution output was visualized by the portal. We believe that, the accessibility of such a grid portal environment has the capacity in advancing the quality of teaching and learning significantly. Based on the strong foundations, hopefully the users are ready to apply their knowledge, creativity and leadership to fulfill the need of their future career development.

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