

Integrating Learning Objects into an Interactive Simulator for Computer Systems

Abstract: In the 21st century, learning is an important concern to most people. However, some e-learning applications contain complicated knowledge structures that may hinder reuse and sharing of knowledge. Previously, we developed a simulator to facilitate the understanding of advanced concepts related to computer systems through live animations. To encourage the sharing and reuses of knowledge, we propose to integrate learning objects and relevant technologies into our interactive simulator. By adopting the IEEE learning object metadata (LOM) standard, our simulator may easily exchange or reuse learning objects of relevant concepts with other e-learning systems.

Introduction

The IEEE Learning Object Metadata (LOM) standard [3] has become more and more popular among the eLearning community. By properly breaking down the original content into learning objects, course content developers can easily maintain and update the knowledge structure of the underlying subjects, and also make the content easily available to encourage the sharing or reuse of relevant materials, especially to facilitate interactive discussion during and after classes.

In a previous e-learning project funded by Microsoft Research Asia (MSRA), we built the COMPAD simulator to facilitate the understanding of concepts related to computer systems through live animations of events for program execution on relevant components [5]. To promote the advantage of learning objects and related technologies in our educational simulator, we propose to integrate a flexible LOM editor and general-purpose multimedia system to enhance knowledge sharing. The functions of the system includes simulating the execution of an assembly program on the selected computer architecture, implementing relevant concepts as learning objects into the simulator so that users can modify the existing learning objects to create his/her learning objects based on the underlying application domain. Also, it provides a platform for users to create new computer architectures using learning objects depending on their own needs and preferences, with a multi-media system [2] that can be selected by users to show and display the resources and information provided for the selected learning objects.

The paper is organized as follows. Section 2 reviews the system architecture design of the resulting simulator. Section 3 shows the prototype implementation and evaluation. Finally, the conclusions and future directions are described in Section 4.

The Architecture Design of the Simulator System

The core functions offered by the COMPAD simulator are provided by the simulation engine [1] and the multi-media controller. The roles of these two components are shown in the system architecture design in Figure 1.

Basically, the simulation engine reads in the three configuration files and the source program to generate a sequence of attractive animation. On the other hand, the multi-media control reads information of the metadata for learning objects and the corresponding users' options to retrieve a specific multi-media file, such as an image or video, stored in the local server.

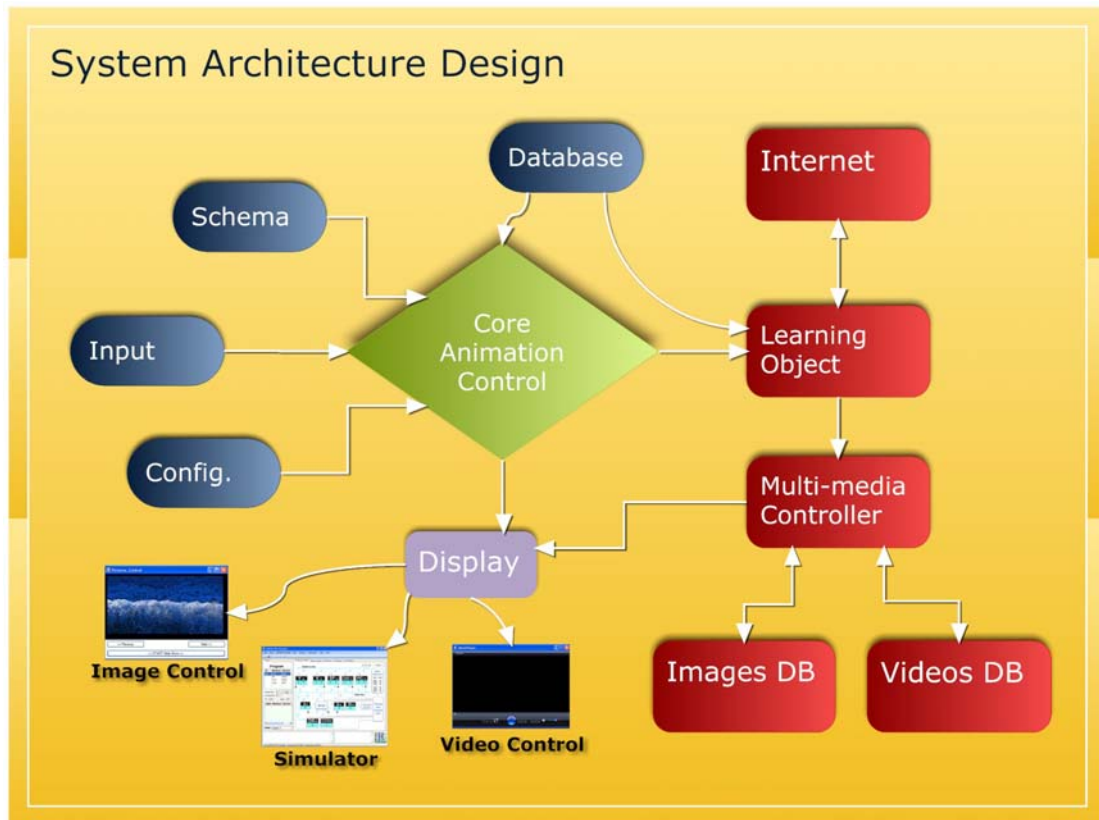


Figure 1: System Architecture

In general, users can simply import the saved assembly program or directly key in the program in the COMPAD simulator. The results generated after the simulation will then be displayed in the simulator. Users can learn more from the information provided in the field of the schema design. There is a platform provided for them to view the related information of the selected learning object so that they can have a clear idea of what the learning object is doing and their inter-relationship more quickly. For more experienced users and designers, they use not only what is provided in the simulator, but also creating something new according to their knowledge about the computer architecture and ultimately integrating them into their designs. They can also search for information that is stored in the schema according to their preference and show it in different media by displaying the images or videos that are stored in the definitions of relevant learning objects.

Prototype Implementation and Evaluation

We have successfully built a simulator embedded with a platform to help users to tackle with their problems regarding computer architecture by retrieving relevant information. The role of LOM in our project is to capture explicit knowledge, context, perspectives, and opinions. The information retrieved can be obtained either from the web or from the database in the form of textual, images or videos, which is monitored by the multi-media controller. Thus, each user will be able to access, discover and find information. Hence, the processes of learning and knowledge creation can be enhanced and accelerated.

Figure 2 and 3 show the LOM editor and the multimedia control developed respectively for our COMPAD simulator.

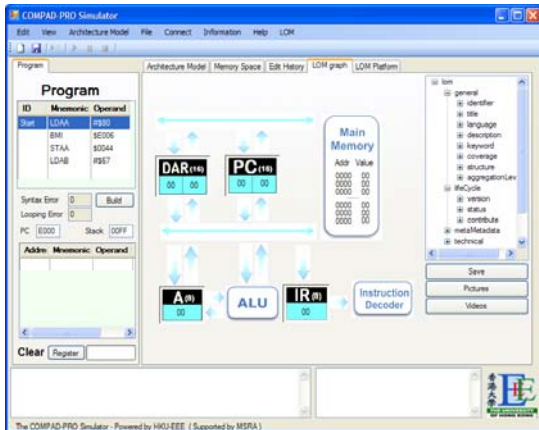


Figure 2: The LOM Editor

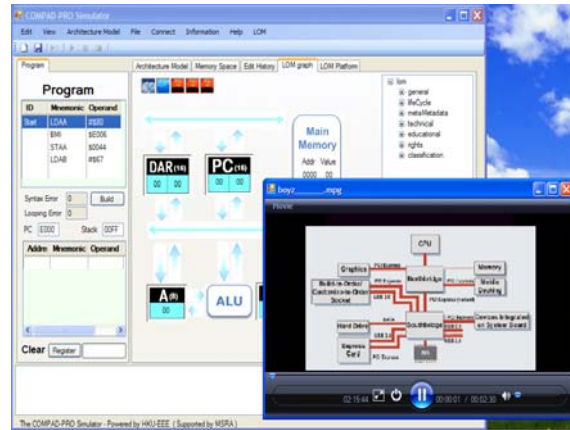


Figure 3: The Multimedia Control

Through the resulting simulator integrated with the LOM editor and multimedia system, users can create the learning objects to suit their needs simply by drag-and-drop, and linking them together according to their relations. For the schema of learning objects, the LOM editor provides convenient facilities to add, modify or remove any content of the learning objects in the schema so as to create their own definitions. Besides, the multimedia system gives flexible supports to display images or videos as readily embedded in each learning object.

Conclusions

We integrate a learning object metadata (LOM) facility into an educational simulator for users to create and work with the specific learning objects in the underlying subject area. The system is generic so that users may reuse or modify the information inside the existing learning objects so as to create their own learning objects to suit their needs. This will help to shorten the development time of relevant course or simulation materials. All in all, our work has many possible future extensions including the use of sophisticated visualization techniques to guide the systematic structure of learning objects in a specific field, or the integration of an interactive discussion forum to foster the exchange of ideas among students over a peer-to-peer network.

References

- [1] E. Brewer , C. Dellarocas , A. Colbrook , W. Wehl. "PROTEUS: a high-performance parallel-architecture simulator", ACM SIGMETRICS Performance Evaluation Review, Vol. 20, No.1, p.247-248, June 1992.
- [2] T. Kleinberger and P. Müller. "Content Management in Web Based Education". In *Proceedings of Webnet 2000 Conference on the WWW and Internet*, pp. 329 – 334, San Antonio, Texas, USA, October 30 - November 4, 2000.
- [3] The IEEE WG12 Working Group. "Draft Standard for Learning Object Metadata". (IEEE 1484.12.1-2002), URL at: http://ltsc.ieee.org/wg12/files/LOM_1484_12_1_v1_Final_Draft.pdf, lastly visited on September 11, 2009.
- [4] J. Vargo, J.C. Nesbit, K. Belfer, and A. Archambault. "Learning Object Evaluation: Computer-mediated collaboration and inter-rater reliability", *International Journal of Computers and Applications*, Vol. 25, No. 3, p. 198 – 205, 2003.
- [5] J. Yeung, V. Tam, E.Y. Lam, and C.H. Leung. "Developing An Innovative and Pen-Based Simulator to Enhance Education and Research in Computer Systems", In

Proceedings of 9th IEEE International Conference on Advanced Teaching Technologies (ICALT 2009), pp. 267 – 269, the IEEE Computer Society Press, Riga, Latvia, July 14 – 18, 2009.

Johnny Yeung

Department of Electrical and Electronic Engineering,
The University of Hong Kong, Hong Kong.
johnnykh@gmail.com

Vincent Tam

Department of Electrical and Electronic Engineering,
The University of Hong Kong, Hong Kong.
vtam@eee.hku.hk

Edmund Y. Lam

Department of Electrical and Electronic Engineering,
The University of Hong Kong, Hong Kong.
elam@eee.hku.hk