

Conceptual Design of L3OP Distributed Database System

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Abstract. This paper presents an idea of designing the L3OP system using distributed database. Existing centralized database Learning Objects based system can not well-organized the large volume of Learning Objects especially when time goes and data volume increasing continuously. It influences the data processing performance which may not run efficiently when the system with extremely large amount of data. The goal of designing the L3OP system using distributed database is to enable end users to search, retrieve, assemble and reuse the Learning Objects where the Learning Objects will be distributed to different database that stored in different location.

Key-Words: learning object, L3OP, distributed database, e-learning

1 Introduction

The system named L3OP, which is taken from Learning Objects Technology for Object-Oriented Programming. It is a reusable contents e-learning system which is using distributed database.

Most of the Learning Objects based systems are applying a centralized database model in which a central database stores on single server. However, centralized model has its limitations such as data searching and retrieving time will be delayed when data volume is increasing continuously and the problem becomes worst if there is without a good database design. In general, performance problems could arise [2] in centralized database Learning Objects system with a single centralized repository when the number of Learning Objects increases. It may able to handle data searching and retrieving process efficiently at the early stage of the system. But when time goes and data volume is increasing continuously, it is not an easy job for the system to perform the data searching and retrieving task especially when particular file type of data is required to be searched and retrieved within short time period.

Besides, the reusability of Learning Objects [1] is greatly limited by current available system for locating Learning Objects. In that case, Learning Objects are located in a particular location or a particular format, and are proposed for one kind of use only. Vision of Learning Objects should encompass the reusable characteristic that enables user dynamically construct, modify and distribute contents among multiple contexts.

In order to improve the limitations of the centralized database Learning Objects based application, reusable distributed object databases approach will be an alternative to dedicate improvement of knowledge delivery and sharing in the academic domain.

2 Project significance

The approach of distributed database onto Learning Objects makes the system has fewer problems in managing the content and the volume of the database. There will be more than one database involved, which it allows a lot of data can be stored. This project improved accessibility to information and ease in updating content.

3 Project Objectives

The objective of this project is to develop a reusable distributed database for Learning Objects based application that enables end users to search, retrieve, assemble and reuse the Learning Objects. In this project, learning content will be broken into reusable sized units and grouped into different categories, which are graphics, text, audio and video. Each of the units will be distributed to their own database that stored in different location in the computer network.

4 Project design

In this section, system architecture, entity relationship diagram, database design, class diagram, interaction overview diagram that involved in the project design will be discussed individually.

4.1 System Architecture

This project used distributed database approach into Learning Objects system. It consists of a central database server and several distributed data server in order to hold the Learning Objects. Each data server stores a single data file type. It is different from the existing database architectural in which all data stores in one central database server.

Fig.1 illustrates the system architecture that is divided into two parts, which are client-side and server-side. Client-side application is the main operation system for the L3OP distributed database Learning Objects system. Server-side application is a socket that used to receive required information passing from client-side application and send the required results back to the client-side application. However, distributed database concept will be implemented into the client-side application only. And the dotted area that appears in Fig.1 is the server-side application will be excluded from the distributed database implementation.

In the client-side application, offline database was divided into master database and several file type databases which are the image database stores image files with format of .gif, .jpeg, and .bmp. The audio database stores multimedia files with format of .wav, .avi and .swf and the text database stores text files with format of .txt. The personal learning content server stores all the registered users personal learning content files and it will be identified by registered user name. The master database stores the base files that needs to operate the system.

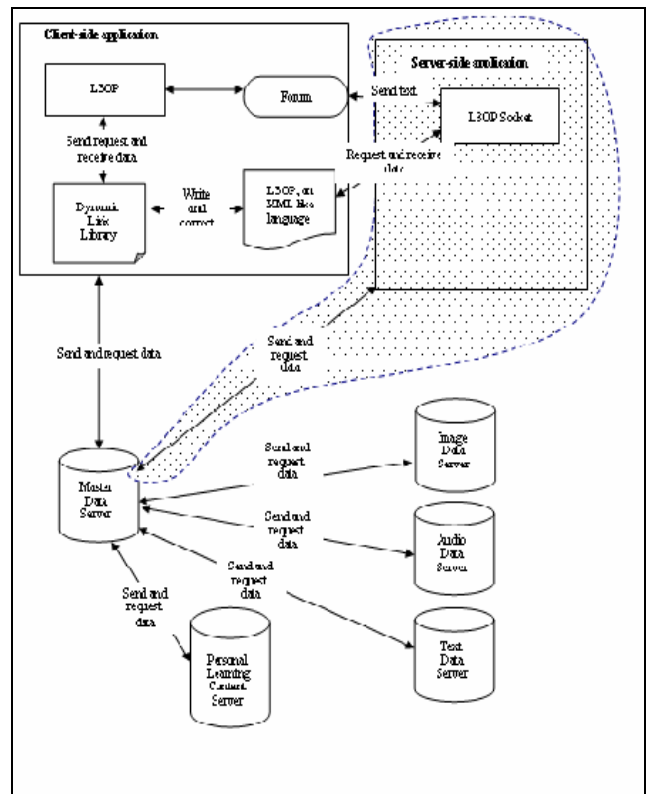


Fig. 1 System Architecture

4.2 Entity Relationship Diagram

In Fig. 2 illustrates the entity relationship diagram for L3OP distributed database Learning Objects system. Basically, this system has nine entities: User, Personal Learning Content, Content Picture File, Last View Chapter Record, Board File, Image Data, Audio Data, Text Data, and Sharable Content. Every single record in the table is a Learning Objects and every field in a table is the metadata for the Learning Objects.

In this project, Learning Objects has been broken down into small size and allows to be reused in different learning context. Learning Objects that in graphics, text and multimedia representation are broken into small reusable sized units, and stores in different tables. Tables which are stored reusable Learning Objects are: tbl_Image_Data, tbl_Audio_Data, and tbl_Text_Data. In the mentioned three tables only store the file data and tbl_Board_File stores the metadata of the reusable Learning Objects. The objective of this fragmentation is to improve the effectiveness in managing the content and the volume of the database.

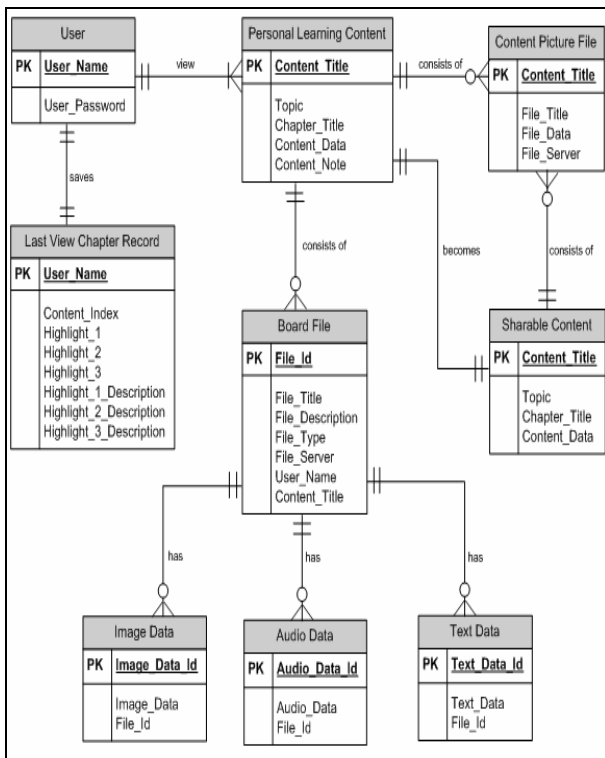


Fig. 2 Entity Relationship Diagram

4.3 Database Design

Fig.3 illustrates the database relationship of the system. There are ten tables involved in the system database such as `tbl_Last_View`, `tbl_Contents`, `tbl_Register_User`, `tbl_Default_Picture_File`, `tbl_Content_Picture_File` (new), `tbl_User` (new), `tbl_Board_File`, `tbl_Image_Data`, `tbl_Audio_Data`, and `tbl_Text_Data`.

Table "`tbl_Last_View`" is used to record the chapter that user last view and other information. Table "`tbl_Content`" is used to record the sharable learning contents or contents of Learning Objects. Table "`tbl_Register_User`" is used to record registered users details. Table "`tbl_Default_Picture_File`" is frame and contain the picture file for learning C programming. Table "`tbl_Content_Picture_File` (new)" is used to record the picture file that is found in are user defined table and are created when a new user registered to the system. Table "`tbl_User` (new)" is used to record user personal learning contents. Table "`tbl_Board_File`" is used to record the external file such as animation file, multimedia file and image file id and information. Table "`tbl_Image_Data`" is used to record image file data. Table "`tbl_Audio_Data`" is used to record audio file data. Table "`tbl_Text_Data`" is used to record text file data.

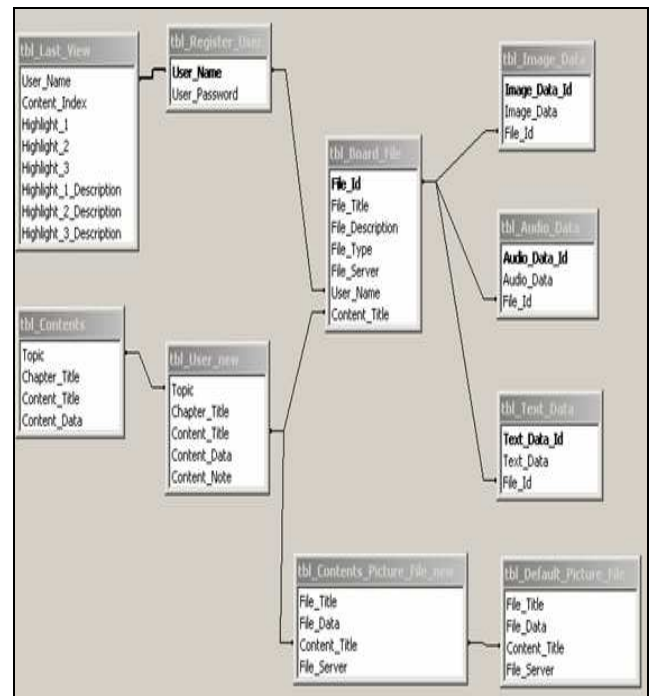


Fig. 3 Database Relationship

Fig. 4 illustrates the distributed database design of the system; it shows the tables that were involved and the tables' allocation to the data servers in the system.

The master data server contains a database named "MasterFileDB". The tables in the "MasterFileDB" database are: "`tbl_Last_View`", "`tbl_Contents`", "`tbl_Register_User`", and "`tbl_Board_File`".

On the other hand, the personal learning content server contains a database named "PersonalLearningContentDB". The tables named "`tbl_Content_Picture_File` (new)", and "`tbl_Default_Picture_File`" are stored into the "PersonalLearningContentDB" database.

The image data server contains a database named "ImageDataDB" that stored a table named "`tbl_Image_Data`". The audio data server contains a database named "AudioDataDB" that stored a table named "`tbl_Audio_Data`". The text data server contains a database named "TextDataDB" that stored a table named "`tbl_Text_Data`".

Normally, the system will be retrieved the data from "MasterFileDB" database in the master data server to get the learning content details. If there were additional files included in the personal learning content then the system will be retrieved the associated files from the relevant data server accordingly.

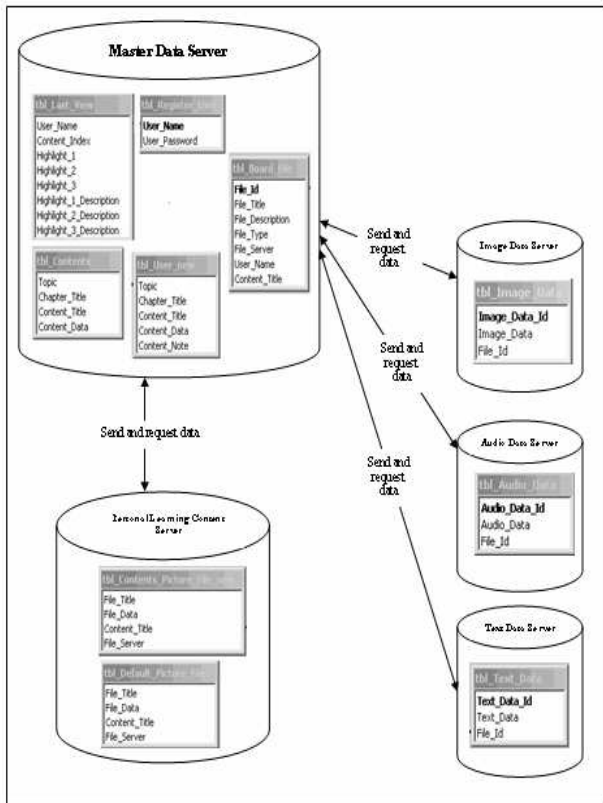


Fig. 4 Distributed Database Design

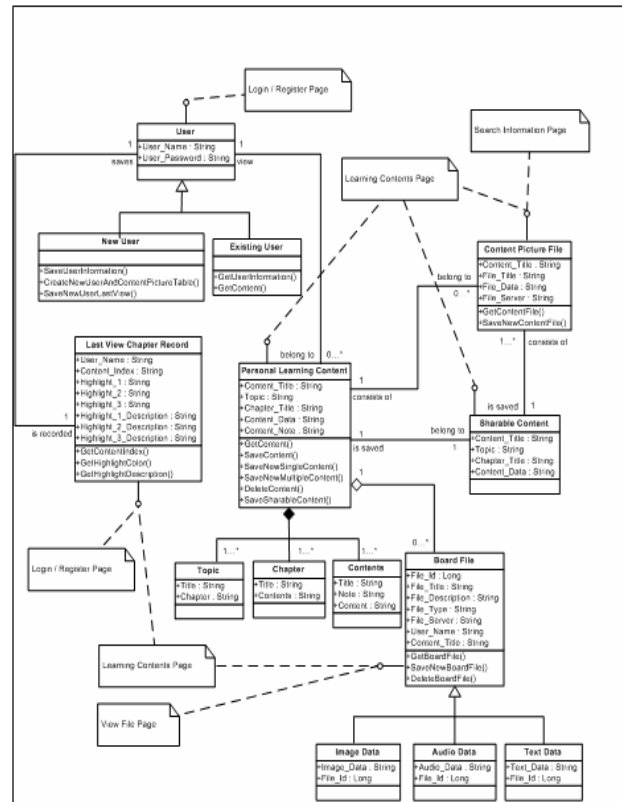


Fig. 5 Class Diagram

4.4 Class Diagram

In Fig.5 illustrates the class diagram for L3OP distributed database Learning Objects system. In the Login / Register Page, there are two options either the user is New User or Existing User. New User and Existing User are the subclasses for the User class.

User can highlight the learning contents and that action is recorded in the Last View Chapter Record class.

After logged in to the system, user can view the learning contents via the Personal Learning Content class which containing a collection of learning contents. Personal Learning Content class is composed of one or more Topic, one or more Chapter, and one or more Contents. Personal Learning Content contains of zero or many content picture files. The collection of content picture files is stored in Content Picture File class. There is no duplicate of title of contents are allowed to be saved; therefore every Personal Learning Content is unique in the Sharable Content class. Board File class is a part of Personal Learning Content class.

In the Board File class consists of three subclasses Image Data class, Audio Data class and Text Data class.

4.5 Interaction Overview Diagram

Fig.6 illustrates the system interaction overview diagram that provides an overview of the process flow. At the beginning, user is shown with login and register page. User is required to enter his or her registered user name and password for verification. If the details matched with the records found in the database, the system retrieve the learning contents from his or her personal table on database. If the data entering did not match with any records in the database, the system informs and requests user to enter the correct user name and password or request user to register again to the system.

In order to use the system, users need to register to the system. After registration, new table for new user will be created to record their personal learning contents. In the registration process, system records the new user name and password that had been entered. However, a same user name is not allowed in this system because this can cause a conflict when creating a new table. Each new created table attached with the user name, therefore if two same user names exist in the system, retrieving learning personal learning content process will be encountered problem in identifying which table suppose to be retrieved. If the user name is found in the database, the system informs the new

user to enter a new user name. A list of registered user name can be viewed from drop down list box for user name on the log in frame. After successfully registered to the system, system guides the new user to choose the available contents of sharable Learning Objects to add into their initial personal learning contents. Sharable Learning Objects are existing Learning Objects that have been created and to be shared among users. However, this process is not compulsory because user can choose to add the contents in future.

Basically, the process flow that uses Learning Objects begins after user successfully login to the system. Every time a user login to the system, the system retrieves the Learning Objects from the user personal database and display the content of Learning Objects on the Learning Objects Page screen. Content of Learning Objects on the Learning Contents Page is ready to be viewed or modified. Users are allowed to perform traditional learning styles such as highlighting the text and clear the highlighted text, write note and information searching via Google.com that are the features tools provided in the system. Any changes on the content of Learning Objects will be recorded if the save operation is performed. Besides, the user can create a new Learning Objects or share the existing personal Learning Objects among the registered users also. Most of the functions provided in the system are simple and easy to use.

In order to access to the forum for discussion, the user must login to the system first. In the forum interface, all the online registered users will be listed out. Users can have a discussion among online users and send file to any users that available in the forum also.

In the Search Information Page, users can perform the information searching by entering a term, word or phase to the system. The system performs the searching job from Google.com and extracts the first 30 searched results. The results are displayed to user in the list box with URL and its description. Besides, the system also searches from the sharable contents of Learning Objects that stored in the database. User can save the information found as their personal learning contents.

In this system, Learning Objects can be a combination of text, image, animation, sound and video. View and play file process in this system is used to view image files, play multimedia file or animation file that associates with Learning Objects. When the file is requested to view or play, the system retrieves the selected file data string from database and convert it to the original format file

type for viewing or playing purposes.

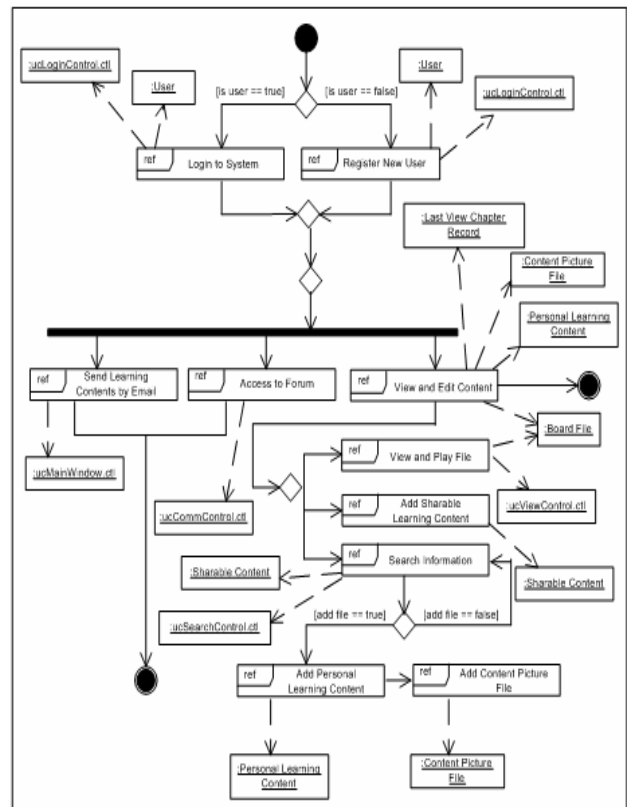


Fig. 6 System Interaction Overview Diagram

5 Conclusions and future works

In this paper, we have explained the conceptual design of L3OP distributed database Learning Objects system. A reusable distributed database for E-Notes modules has been developed in which users able to search, to save, to edit and reuse the Learning Objects in graphics, text, audio and video representation across the computer network.

For the future, the instructional design of the L3OP in composing and personalising lessons could be optimized to automatically and dynamically compose personalized lessons for an individual learner. Besides learners can be uniquely identified and content can be specifically personalized, the learner progress also can be monitored, supported, and assessed. Assembling learning objects to create supportive, personalized learning environment is an additional challenge. Furthermore, as L3OP distributed database system will continue to manage massive and large volume of data; efficient distributed query and request execution should be optimized and studied further. Hopefully, this project brings some ideas to those who are interested on reusable distributed database for Learning Objects studies.

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