

# Architecture for Multimedia Content - MMWBI

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**Abstract—** Multimedia Web-Based Instruction (MMWBI) is teaching and learning content delivered over the Internet. The content can be a combination of different representations including text, images, interactive animation and video. The software design and implementation of the system is most important. Most of the development models mix the code of data access, the processing of business logic, and web presentation layer together. Novice developers often have trouble with system development and system maintenance. In this research, we present the architecture for multimedia content based on MVC pattern. The MVC pattern is very useful for the architecture of web applications, separating the model, view and controller. A model represents the business logic and data for the application. A view is the visual representation and user interface of a controller. A controller handles the user actions and invokes changes on the model. In addition, a MMWBI application is being built to verify and validate this architecture.

**Index Terms—** Multimedia Web-based Instruction (MMWBI), MVC pattern, Model, View, Controller

## I. INTRODUCTION

The advances of Internet technology introduce Web-Based Instruction (WBI) that offers many advantages in educational management. WBI is not restricted by the time of courses and place for learning. The learners can study at anytime and anywhere over the Internet. In addition, WBI is reflected in its nonlinear interaction. The learners can control their order and pace of learning. With the advent of multimedia technology, WBI can be a combination of different types of representations including text, images, interactive animation and video. Multimedia contents will increase the effectiveness of learning. This learning is called Multimedia Web-Based Instruction (MMWBI). The software design and implementation of the system is most important. Most the development models mix the code of data access, the processing of business logic, and web presentation layers together. As a result, it brought about many problems in the web applications [1].

One way to solve the problem is to develop an application based on MVC pattern. The MVC is an architectural pattern that breaks an application into three modules: model, view and controller. The model module is the business logic of the application and is the core of the application [2]. The view is the user interface of the controller. It is the public face of the user event's response [3]. The controller

component implements the flow of control between the view and the model [4]. By decoupling the module, MVC helps to reduce the complexity in architectural design and increase flexibility. The advantages of this pattern are, for example, loosely-couples, parallel development, expansibility, and maintenance. This research proposes the architecture for multimedia content based on MVC pattern, which will be an effective separation of business logic, user interface and event handling. In addition, the prototype of MMWBI is built to test this architecture.

The remainder of this paper is organized as follows: Section 2 describes the related works. Section 3 discusses the architecture for multimedia content. Section 4 shows MMWBI implementation based on architecture for multimedia content. Section 5 draws the conclusions and proposals for future research.

## II. RELATED WORKS

There is some research work that designs the architecture of Web-Based Instruction (WBI). Tsung-Yu Liu and Tan-Hsu Tan [5] design and implement a learning management system—the WISH (Web-based Instruction System for High school). There are six components of the WISH platform: system management, material management, courses management, virtual classroom, matters and learning resources and EZ author. The system management manages teacher's data and student's data, materials, matters, learning records, system configuration, and learning resources by the system management interface. The materials management supports three kinds of materials: standard, self-study, and private materials. These materials are used for learning activities. The courses management is used for adding, updating and deleting the classes, activities, or materials. The virtual classroom is composed of learning materials (standard materials and private materials), learning activities (bulletin board, learning community, learning record, chat, quiz, notebook, and FAQ), and learning resources (dictionary and web site resources). The matters and learning resources provides matter resources, which were classified by subject and were stored in a database. Those matters include various object files. A teacher can download these matters to a local computer and then integrate them into the course materials in order to enrich the course materials. The EZ author is an easy-to-use authoring tool in WISH, which is a Windows application. A teacher can easily create web-based material. In this research, the system employed was a top-down designed model in which developers map out the overall program structure into separate subsections. Moreover, the program mixes the code of data access, the processing of business logic, and web presentation layer together. This is the problem in the development phase and maintenance phase.

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We aim to alleviate the problem by designing the architecture based on MVC pattern.

More recently, efforts have been undertaken to design and develop an education system on the MVC pattern. Caizian Chen and Huijian Han [6] designed and developed distance education systems by using the MVC pattern. The model classes are applied to carry out Model components in MVC pattern. There are three kinds of classes: business object classes, application classes and testing class. The business object classes support a table in a backstage database. The application classes are used to delegate all entities the system knows. For example, connect/disconnect the database, add/update/delete examination questions, etc. The testing class is a tool class to test the model class. The controller component is there to operate the model and change its states, in line with a user's input. The view creates the dynamic pages that return to the user based on the result of business processing. Pandit S, Acharya H, Sanvedi A, Nahar P, Soni S.K, Saxena P, et al. [7] designed and developed an architecture solution for E-learning systems. The architecture is divided into four layers: presentation tier, common service tier, E-school service tier and resource tier. The presentation tier handles the interaction between the user and the application. It will work as a bridge between user and implemented services of the ESS's components. The common service tier consists of the authentication and authorization module, which represents the service that every user needs to access ESS. It also controls the functions, communicates with the presentation tier and presents the obtained result to the users. The E-school service tier consists of four components; the Information Management System (IMS), E-Learning System (ELS), Test and Assignment Management System (TAMS) and Result Management System (RMS) components. This tier is responsible for providing basic features of ESS application to the users. The resource tier is a bridge between the database and resource repository server. This tier is responsible for managing resources in the ESS application on the basis of module. In addition, these layers were grouped in MVC pattern. The presentation tier is a view component. The common service tier and E-School service tier are controller components. The resource tier is a model component. In these architectures, the component was divided by MVC pattern, which can solve the problem regarding system development and system maintenance. However, the multimedia content still does not separate the different types of representations: text, images, interactive animation and video. We separate the different types of representations in each object.

### III. PROPOSED ARCHITECTURE FOR MULTIMEDIA CONTENT

In this section, we focus on the architecture for multimedia content. Its purpose is to help users implement and manage the multimedia web applications. The architecture for multimedia content is shown in Fig. 1.

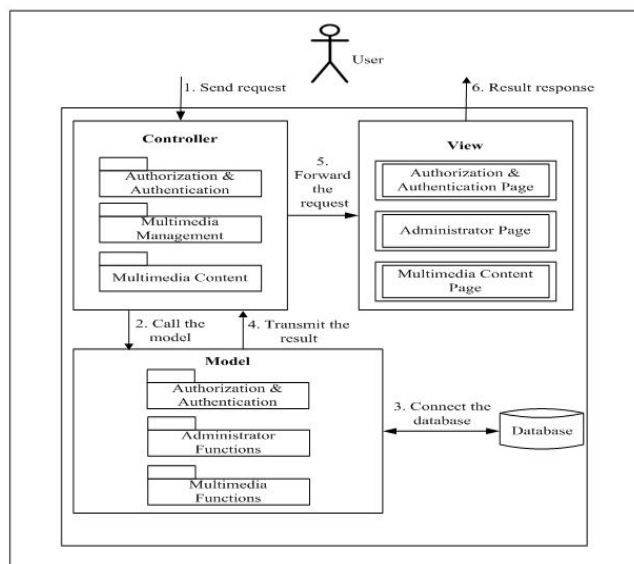


Fig. 1. Architecture for Multimedia Content

#### A. Architecture Overview

The MVC pattern breaks the architecture into three modules: model, view and controller. Firstly, the model module contains the underlying classes. There are three classes in the model module: Authorization & Authentication class, Administrator Functions class and Multimedia Functions class. Secondly, the view module is the user interface of the controller. There are three parts in the view module: Authorization & Authentication Page, Administrator Page and Multimedia Content Page. Finally, the controller module contains code to handle the user actions and invoke changes in the model. There are three classes in the controller module: Authorization & Authentication class, Multimedia Management class and Multimedia Content class.

#### B. Component in Architecture

There are three components in the architecture. Each component has its special responsibility to handle a particular kind of job. The architecture and functionality of each component is explained as follows:

##### Authorization & Authentication

In order to provide authorization and authentication to the users, the system should have a mechanism for identifying the user and processing permission for the user. A user may be a system developer, which sends a request (username and password) to the controller. The controller receives the request and calls the model. Then the model will perform the Authorization & Authentication class that checks the correctness of the username and password in the database. The result of login system will show in the Authorization & Authentication page in the view module. The Authorization & Authentication component and functionality is shown in Fig. 2.

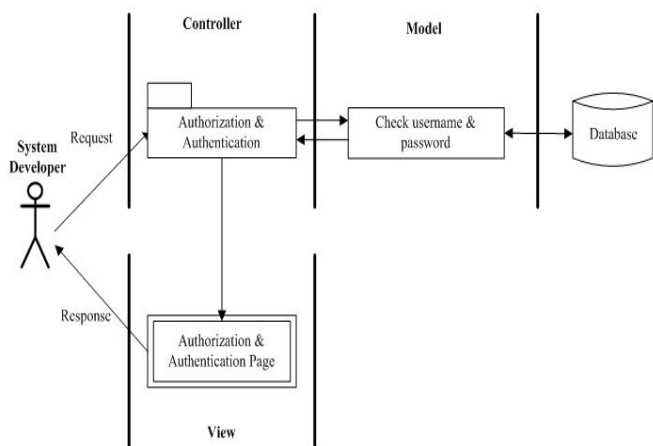


Fig. 2. Architecture of Authorization & Authentication Component

### Multimedia Management

In order to create a multimedia application, the system should have a function to insert, update and delete multimedia content. A system developer sends a request to the controller. The controller receives the request and calls the model. Then the model will perform the Administrator Functions class that is comprised of the insert function, update function and delete function. These functions are used for content management; for example, chapter, topic and multimedia content. The result of multimedia management will show in the Administrator page in the view module. The Multimedia Management component and functionality is shown in Fig. 3.

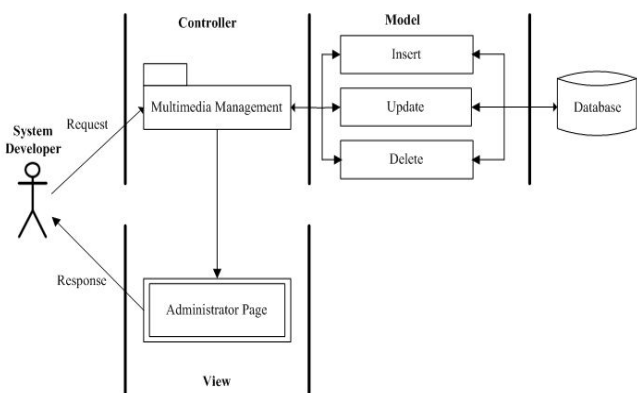


Fig. 3. Architecture of Multimedia Management Component

### Multimedia Content

In order to present the data in multimedia content format, the system should have a function to retrieve the multimedia content. A user sends a request to the controller. The controller receives the request and calls the model. Then the model will perform the Multimedia Functions class that is comprised of the getText function, getImage function, getVideo function and getAnimation function. The result will show in the Multimedia Content page in the view module. The Multimedia Content component and functionality is shown in Fig. 4.

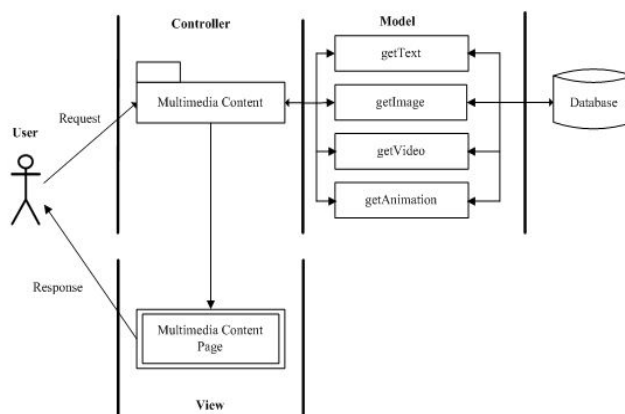


FIG. 4. ARCHITECTURE OF MULTIMEDIA CONTENT COMPONENT

## IV. MMWBI IMPLEMENTATION

In this section, we show application of MMWBI based on the architecture for multimedia content. The data example is Data Structure and Algorithms course. The database of MMWBI and relationships between individual tables is shown in Fig. 5.

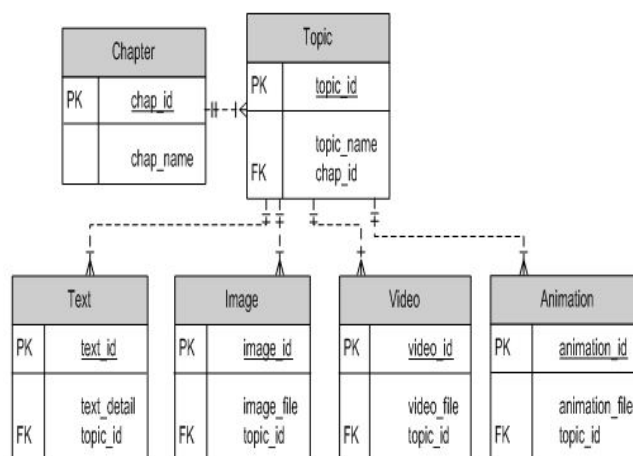


Fig. 5. Entity diagram of the MMWBI

The MMWBI application was implemented with CodeIgniter which is an open source web application framework based on MVC pattern. The database was created with MySQL. The resulting response will display in the Internet browser.

Fig. 6 shows the example of data in text format and video format. The process of architecture starts from the Multimedia Content class in controller module which calls getText function and getVideo function in the model module. After that, these functions connect to the database to retrieve text data and video file. The model module transmits the result back to the controller module. Then, the controller module forwards the request to the Multimedia Content page in the view module.

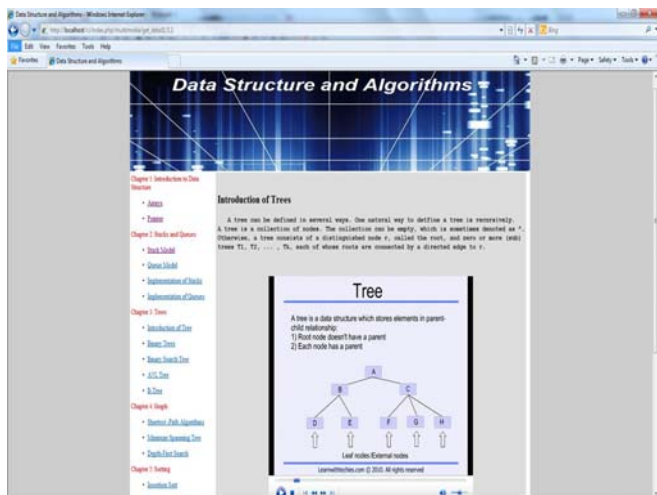


Fig. 6. Example of MMWB in text format and video format

Fig. 7 shows the example of interactive animation format. An animation is a continuous motion created by displaying a series of pictures or frames. The process of architecture starts from the Multimedia Content class in controller module which calls getAnimation function in the model module. After that, these functions connect to the database to retrieve animation file. Adobe Flash file format (swf.) used for interactive animation. The model module transmits the result back to the controller module. Then, the controller module forwards the request to the Multimedia Content page in the view module.

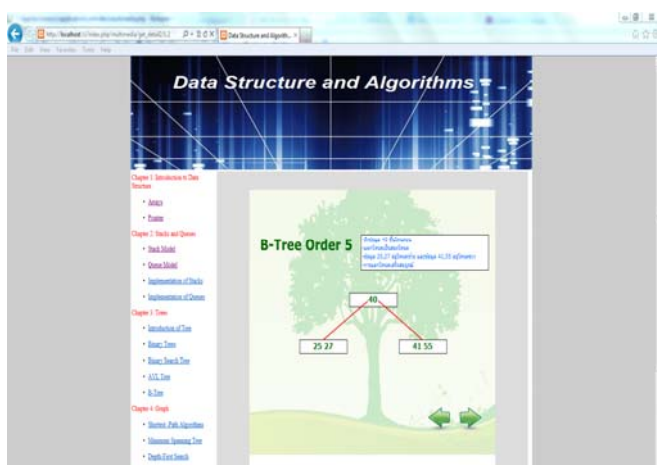


Fig. 7. Example of MMWB in interactive animation format

## V. CONCLUSION AND FUTURE RESEARCH

In this research, we have researched the architecture for multimedia content. The architecture was designed based on MVC pattern: model, view and controller. Each module is self contained and can be optimized independent of other modules [8], [9]. The MVC pattern takes full advantages of its loosely-coupled, parallel development, expansibility and maintenance. In addition, there are three components in the architecture: Authentication & Authorization, Multimedia Management and Multimedia Content. The Authentication & Authorization is used to check the correctness of username and password in a database. The Multimedia Management is used to Administrator functions. The Multimedia Content is used to retrieve the data in multimedia format.

In future research, this architecture may be applied to other web applications, for example, E-commerce application that shows the details of products in multimedia format.

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