

Design and Implementation of Teaching System for Mobile Cross-platform

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Abstract

With the development of mobile intelligent terminal, the mobile learning has become an efficient way to learn. However, there are a few work related to the mobile learning system construction in current China. This paper proposed a novel method based mobile cross-platform to construct the learning system, which can be used for teachers to teach and students to learn whenever and wherever. To meet the demand of the cross-platform and multi-terminal, we use the mobile Internet, the HTML5, the Responsive Web Design technology, and the MVC technology architecture. Experimental results show that the proposed method can work effectively and can be widely used in the teaching system.

Keywords: *Mobile Internet, Teaching and Learning, cross-platform, HTML5, Responsive Web Design, MVC*

1. Introduction

Rapid growth and popularity of smart phones had made mobile learning into a new way of learning and teaching, causing the majority of scholars to research. Mobile learning has broad application prospects. However, the vast majority of domestic teaching systems are designed for traditional PC and do not support the use of mobile terminals. Obviously it can't meet the requirements of teachers and students to use anytime and anywhere. How to make teachers and students to learn urgently by the way of mobile is a time of great significance for research. Domestic research started relatively late, and is mainly theoretical research. There is little research about how to implement mobile teaching platform. In today's massive popularity of mobile, SMS-based [1] and WAP [2] technology to build mobile learning system is significantly outdated. The mobile learning system based on Android [3] or iOS [4-5] have been proposed. But in the current situation which Android and iOS dichotomous world, the research ignoring any a kind of operation system is not comprehensive enough.

HTML5 not only has image processing, multimedia online playing, asynchronous communication and offline storage features, but also has excellent cross-platform, cross-terminal support features. These features make HTML5 as the preferred technology solution to build mobile learning platform.

Most research about mobile teaching platform is based on a single platform [6], either based on android, either based on iOS. Additionally, there is a considerable part based on outdated technology of SMS or WAP. Few researches aimed to build a common cross-platform support for mobile learning platform; therefore, for the development of mobile learning, this research of topic has better guiding significance.

2. The Key Technology of the System

2.1. Overview of HTML5

HTML5 is a new generation of Internet technology standard. It has more descriptive labels. It has a good multimedia support, can play audio and video. It is designed for cross-document communication. It can store in the client, draw and get physical location *etc.* The advantage of HTML5 is cross-platform. Both personal computer, or smart phone, Pad, and even smart TV, can well support HTML5. Similar to the Java cross platform, if using HTML5 technology, the program developed only once can run on different platforms. As the HTML5 becomes more and more mature, web and mobile applications in increasing numbers are beginning to use HTML5. The HTML5-based mobile applications are becoming the mainstream trend of the next generation of mobile Internet applications [7].

2.2. Multi Terminal Display Technology

Users use the system through the PC browser or mobile browser. However, their OS is different. Android, iOS and winphone are for the mobile's OS. Windows and linux are for PC's OS. It's obviously impossible to make a custom native client for each operation system. The traditional HTML in the mobile terminal of compatibility is poor, so that it can't solve the problem. HTML5 has the features of stable performance, beautiful interface, and cross-platform support, and is supported by a variety of devices browser. Using HTML5 technology can help to realize the multi terminal display.

2.3. The Technology of Keeping Unified Visual Experience in Different Screen

For the PC terminal, it has been a relatively mature technology to solve the problem of screen display. With the rapid development of mobile Internet and the rapid popularization of mobile terminals, more and more people use mobile terminal to access the web application. Mobile terminal number has exceeded the PC terminal. Mobile terminal becomes the first entrance for the people to gain the information. Mobile first has become a design trend. But the smartphone is highly personalized, with many of the screen size and resolution, different screen orientation and serious fragmentation. To be specific, the teaching platform not only can provide a friendly interface and user experience on the large size screen of desktop computer, but also can provide a friendly interface and consistent user experience on the so many small screen. There is no suited feeling when the screen is switched. The most direct method to solve this problem is specialized custom version for each equipment; enabling mobile users obtain smooth and friendly user experience in these pages. But in the face of such a severe screen fragmentation, this method does not stop development for different screen version, causing the heavy workload and high cost. So this method is obviously a very undesirable one. This paper proposes the technical solutions of Responsive Web Design. Responsive Web Design is put forward by Ethan Marcotte in 2010, which can automatically identify the screen width, and make corresponding adjustment of webpage design. Simply, a webpage can automatically adapt to different screen sizes, according to the screen width, the automatic adjustment of the layout. The technical scheme of the system uses Bootstrap3.0 front-end architecture which supports the complete response features.

Bootstrap is applied to realize Responsive Web Design through "media query". Media query can make CSS more precise effect on the different types of media and the same media of different conditions, setting the column width for different screen sizes, different font and size. For example,

```
/* Large desktop */  
@media (min-width: 1200px) { .footer{ width:960px;}... }  
/* Portrait tablet to landscape and desktop */  
@media (min-width: 768px) and (max-width: 979px) { .footer{ width:600px;}... }  
/* Landscape phone to portrait tablet */  
@media (max-width: 767px) { .footer{ width:350px;} ... }  
/* Landscape phones and down */  
@media (max-width: 480px) { .footer{ width:300px;}... }
```

2.4. No Plug-ins Online Multimedia

The system needs to support multimedia which not only has graphics, but also has audio and video. The audio and video need to play online. The PC is usually used the Flash to solve. But not all mobile terminals support Flash, such as the Apple iOS devices (iPhone, iPad, *etc.*) are not supported Flash. Because of Flash itself technical defects, In 2011 November Adobe announced the Flash exit the mobile platform. HTML5 can support multimedia online play. HTML5 can meet the requirements of online playing audio and video by "audio" or "video" label.

3. System Design

3.1. The System Function Analysis

The whole teaching system contains two functions of teachers' teaching and students' learning, divided into 3 modules on curriculum management, learning management and background management.

3.1.1. The Course Module: It supports for text, audio and video formats, and the audio and video can no-plug online play. Teachers can easily create and manage courses, upload audio, video and pictures, and add the course materials (such as PPT, teaching video, *etc.*) and test questions. Teachers can also publish course announcements, interact with course participants through attention and private letters, can also look up students' questions, and answer the questions.

3.1.2. The Learning Module: It provides students with online learning opportunities, so that students can view and read courses, record the notes, ask and respond to the questions, download the data and take the online test and etc. The learning module completely records of the whole learning process. The system also has rich interaction between teachers and students through the questions and answers, discussions, concerning for effective communication. Students can evaluate courses by scoring. It promotes the interaction between teachers and students. The teacher can also publish some course announcements in order to guide students to learn.

3.1.3. The Background Management: Including the review and recommendation to the course, user rights management, *etc.*

3.2. The System Architecture

According to above requirements, this paper makes an analysis of the design and implementation of a common teaching platform for mobile Internet terminal cross-platform. The system architecture is shown in Figure 1.

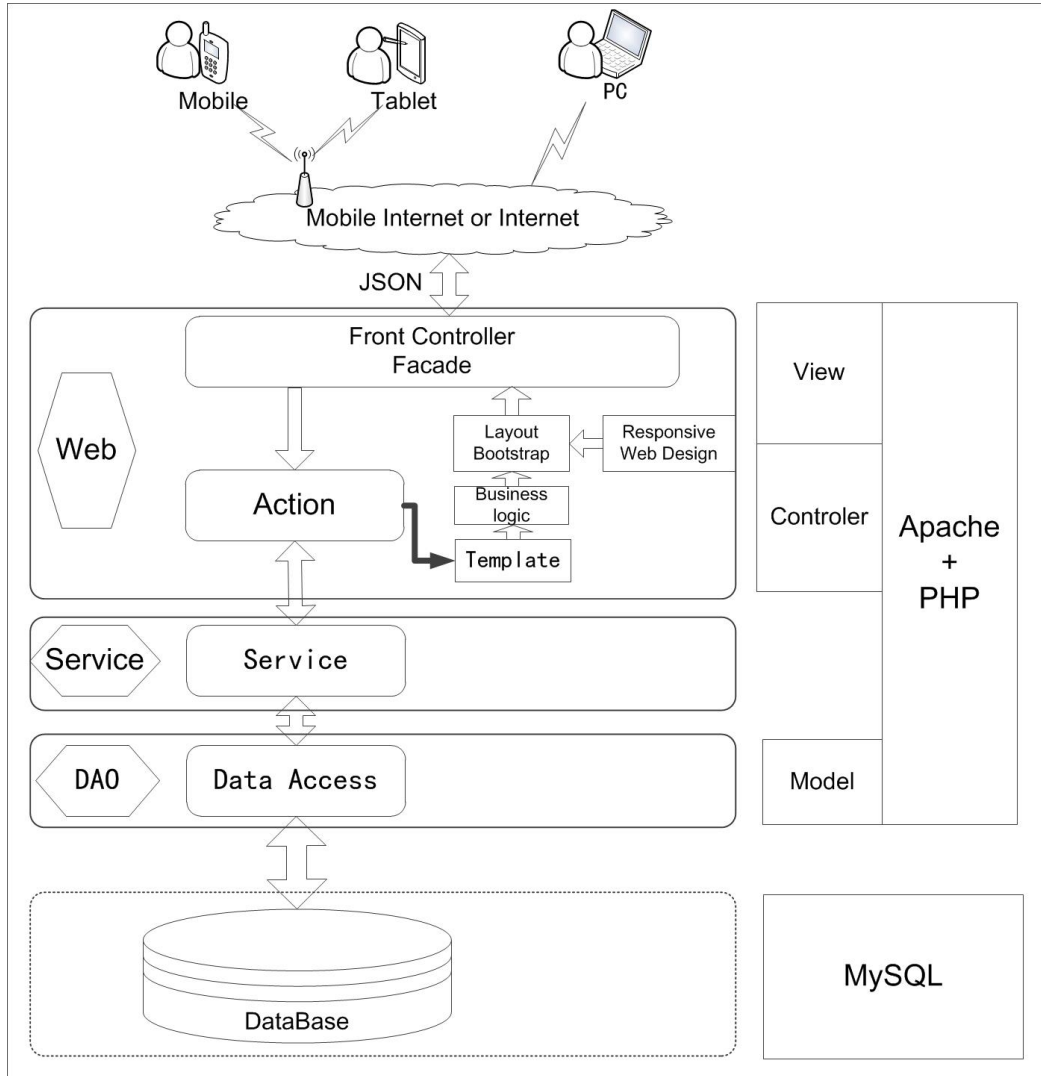


Figure 1. System Architecture

To meet the system performance stability, scalability and maintainability requirements, the system uses the popular open source framework Apache+PHP+MySQL, using the classic MVC architecture. The architecture is divided into four layers from bottom to top, the database layer, the model layer, the control layer and the view layer. The data layer corresponds to the physical database MySQL, mainly used for the storage of data. The model layer is used to package the business logic of the application and processing method on the database. The controller layer is handling user interaction part. Usually the controller layer is responsible for reading the data from the view layer, controlling user input, sending data to the view layer to process, and responding to the request end. The view layer is a display part.

Usually the view layer is created based on the execution results via the model layer. The view layer is mainly responsible for generating HTML5 pages or JSON data.

In the interactive process, firstly user terminal (smartphone, tablet or PC) sends a request to the teaching platform by the mobile Internet or the internet. The Front Controller as a teaching platform accessing facade, receives and analyzes the request of the user, and then processes by invoking the corresponding controller object. The controller object can achieve any business logic by operating database through the service layer to call the DAO layer. The controller object loads the template, performs business logic, then it generates HTML 5 or JSON data according to the result of the business logic, and finally it responds to the client end. It is designed by HTML5, becoming the unified style of display terminal.

3.3. Architecture Implementation

A good system has good system architecture. Mobile teaching platform is not an exception. It has a good designed MVC architecture. As shown in Figure 2.

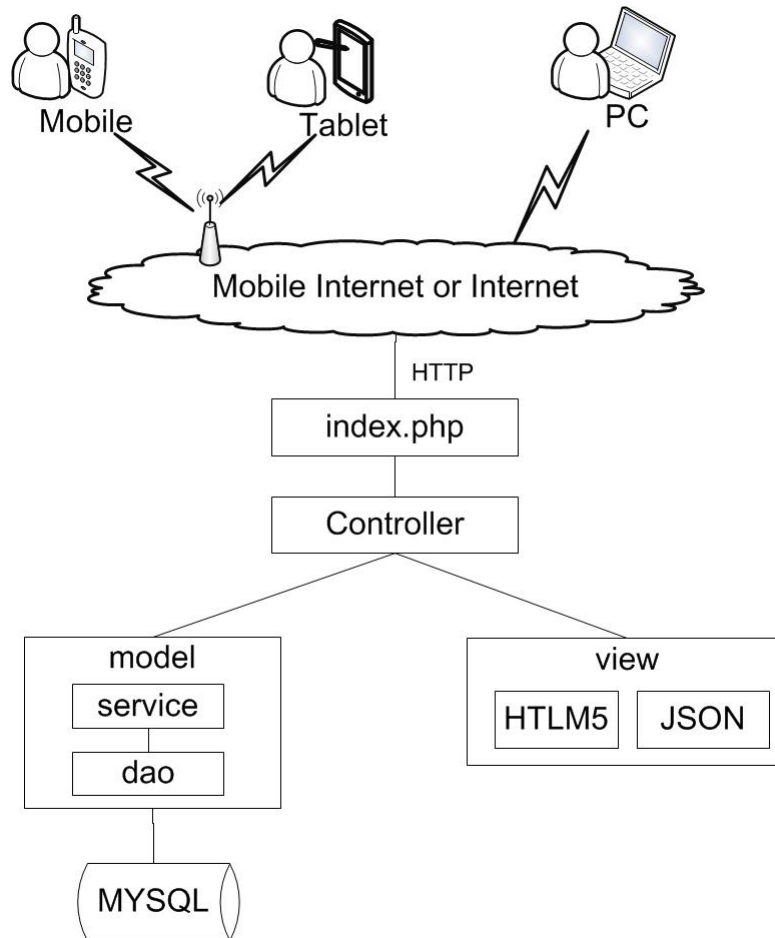


Figure 2. MVC Implementation

"index.php" as a unified system of entrance and exit, is system facade, as like as Figure 1 front controller. As the entrance, requesting URL is mapped to a method of a controller and executes it according to the routing rules. As the exit, it receives controller data, and then outputs by the view. The controller accesses to HTTP data (\$_GET, \$_POST, put, delete),

and passes to the model layer as parameters, then the model layer performs the data and passes to the view layer. A URL corresponds to a method of a class controller. Model is the business logic layer, containing service layer and DAO layer. The service layer processing business logic, calls Dao layer to implement business logic. The DAO layer according to atomic business, packages of various database accessing operations, ensuring the interface unchanged during database migration. The View layer generates HTML5 or JSON format data by handling the result data.

The core of the MVC framework is the routing rules. Routing rules is the rules which associate the user's URL request with the function code. Its working principle is when the web receives a user request URL, the routing rules framework parses it and decides which controller to execute the request and reply. In the routing process, the user request URL is first parsed by the front controller system (index.php), and is forwarded to the routing rules to check. Then the routing rules find and match the received URL routing, and read its configuration information. Based on the configuration information, the framework finds the corresponding Controller classes and methods, and performs it. Finally, the results will be passed to the view which generates a Response object back to the client.

The following discuss the MVC implementation processing, creating a course as example.

1) Define the routing rules. The rules defined in the app/config/routing.yml. The format is as follows.

```
course_create:
  pattern: /course/create
  defaults: { _controller: TopxiaWebBundle:Course:create }
```

"course_create" is the ID of routing rules, must be to ensure the globally unique. "pattern" is a matching rules of URL model. "defaults" is the controller class and its methods of configuration information. The configuration matching rules (/course/create) request URL will be processed by the method createAction of CourseController controller whose namespace is TopxiaWebBundle.

2) Create a controller. "_controller" information of routing rules indicates controller information. TopxiaWebBundle is the controller's namespace. Course is the controller name, controller source code file name must be CourseController.php. Create is the name of method controller corresponding execution. In accordance with the contract, the method name is "createAction". This method implements the business logic if you submit the data and it will create a course object. And if not, it shows that the new course view. The following is core source code.

```
class CourseController extends BaseController{
  .....
  public function createAction(Request $request){
  .....
  // creating the course object when you submit the data
  if ($request->getMethod() == 'POST') {
    $this->getCourseService()->createCourse($course);
    return $this->redirect($this->generateUrl('course_manage',
      array('id' => $course['id']));
  }
  // if Non submission of data, directly display creating curriculum view "create.html"
  return $this->render('TopxiaWebBundle:Course:create.html.twig', array('form' => $form-
    >createView()));
  ...
}
```

The source code display that the CourseController controller call the model layer of the CourseService object and the View layer in the create.html.twig view.

3) Create a view. A view is a Twig template file. Twig is a powerful, high performance, safety and PHP template engine. The template writing with Twig is more readable, more concise. Source code is as follows.

```
<div class="panel-heading"><h2>create course</h2></div>
.....
<div class="md-2 control-lbl"> {{ form_label(form.title, 'title') }}</div>
<div class=" md-8 controls">
  {{ form_widget(form.title, attr:{class:'form-control'}) }}
</div>
```

Braces ({{ }}) which is a Twig label. It indicates the generation "title" label and "title" form input field "input".

4) Create business process object "Service". "Service" belongs to the Model layer. It implements the business logic processing which obtains the parameters from the controller layer, and uses DAO object to call the business logic processing. The method CreateCourse of CourseService achieves the creating course function which firstly check the data, and then call the DAO object CourseDao to store in the database. The following is core code.

```
public function createCourse($course) {
if (!ArrayToolkit::requires($course, array('title'))) {
    throw $this->createServiceException(' The lack of necessary field, create courses failed');
}
// Calls to the Dao object storage course object
$this->getCourseDao()->addCourse(CourseSerialize::serialize($course));
```

5) Create database access object "DAO". "DAO" belongs to the model layer, mainly to provide accessing to the database, provide data access to atomic service layer. CourseDao stored the course object in the database. The following code fragment of core.

```
public function addCourse($course){
.....
// The course information into physical data table.
$this->getConnection()->insert(self::TABLENAME, $course);
.....
}
```

4. Test and Analysis System

Tests were carried out respectively on the Internet and LAN. First, the system is deployed to the server, and then we used the PC browser, the Android mobile terminal (smartphone and tablet) browser and iOS mobile terminal (iPhone and iPad) browser to test each function of the system. The test results are shown in Table 1.

Table 1. The Experimental Results

OS	Interface	Touch control	Audio playback	Video playback
Android	OK	OK	OK	OK
iOS	OK	OK	OK	OK
PC(Win)	OK	--	OK	OK

Table 1 indicates that all functions can be used normally .It can be adapted to different screen display automatically. Interface display effects are good, and the user experience and style are consistent. It supports online playing audio and video, and it supports the touch functionality in mobile terminal very well. When the system was deployed in the Internet, playing video by the mobile 3G network was not smooth. There is the main reason for this problem is the mobile 3G speed too slow. Switching to China Unicom's 3G network, video is smooth. Figure 3 is the test effect of PC terminal, the apple iPad min and Samsung NoteII .It indicates that the platform can well fit the screen, and experience consistent style.



Figure 3. Multi Terminal Display Effect Chart

5. The Conclusion

The teaching system applies the HTML5 technology, mobile Internet and Responsive Web Design technology and MVC framework construction, not only to support different screen size of mobile terminal access, but also to support for PC access, so that teachers and students can use mobile platform to develop equal interaction and make full use of fragmented time. The test results show that the platform has certain innovation and practical value, has certain significance to construction of teaching platform for mobile Internet. The next step will be to increase the role of parents and social functions, the school education, family education, social education, self education and the organic combination of the four together, providing a full range of information services for the students to learn effectively in learning activities.

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