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Research and Application of Ajax Technology in Web Development

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***Abstract*—Ajax technology is now widely applied to the Web development. It not only making full use of existing technical standards to update the page content needs to be updated without refreshing the entire page, but also using XML encapsulation method, makes it more efficient to the operation of the bulk data. Practice shows that, Ajax technology based on XML encapsulation can provide bulk data processing flexible operating methods in Web development.**

Keywords- Ajax; XML; Data processing; Website Optimizing;

I. INTRODUCTION

Ajax is a Web application client technology, which is a combination of JavaScript, CSS, HTML, the XMLHttpRequest object, and Document Object Model (DOM). Ajax applications running in the browser communicate with a Web server in an asynchronous manner, and update only a part of the page. By using Ajax technology, we can enrich the browser-based user experience, and can provide a variety of interactive application mode to meet the socialization and humanization needs of different users [1].

II. AJAX TECHNOLOGY

Ajax (Asynchronous JavaScript XML) is first put forward by Adaptive Path consultants Jesse James Garrett. It uses a series of existing technology, and put them to extend and expand.

Ajax can capture rich user action events, and the Ajax applications only send to the server and retrieve the necessary data. It uses some of the XML-based web service interface, and processes responses from the server by JavaScript on the client side. Because of a significant reduction in the data exchanged between browser and server, the application will respond faster. Also, a lot of work can be completed on the requesting client machine, the Web server's processing time is also reduced. Due to the advantages of interaction, Ajax has been widely used.

Ajax is a collection of the following Web technologies and standards, which allows the client machine running an important part of the application logic in the background.

A. Hypertext Markup Language, HTML

Define the content rendered to the user in a browser.

B. Cascading Style Sheets, CSS

Define the rendered content style.

C. Document Object Model, DOM

A document API, browser delivers the rendered content to JavaScript in Interface-oriented approach with it. Then, JavaScript use DOM to modify the content dynamically before the user sees content.

D. XMLHttpRequest object

Provide interactive communication for the interaction between the browser and server, called by JavaScript.

E. JavaScript

A scripting language executed in the browser, which puts all the other components of the Ajax stick together. The script can listen for events occurred in the browser, and use the XMLHttpRequest callback server to respond to events, and then modify the DOM tree according to the results returned.

At present, the W3C is to standardize the XMLHttpRequest specification. Ajax is widely supported across platforms while other techniques become the standards and implemented by all major browsers, including JavaScript, XML, CSS and the DOM, etc.

III. CHARACTERISTICS OF AJAX

In the traditional Web applications, the user fills out the form and submits to send a request to the server. The server receives and processes the form, and then returns a new page. Most of the two pages HTML code tends to be the same, this traditional method takes up a lot of extra bandwidth. Also, because each interaction is required to send a request to the server, the interaction time mainly depends on the response time of the server, which is much slower than in the local operation. If the user interface response time is serious long, the server will send timeout response and cause the page is unavailable.

Different from the traditional Web applications, Ajax uses asynchronous interaction process. Ajax introduces a intermediate medium between the user and the server to eliminate the defect of waiting for response after each operation in the process of network interaction. That is to say, between the user and the server adds an intermediate layer to make the user operation and server response asynchronized. This put some of the work done by the server before transferring to the client, make full use of the client idle processing power, reducing the burden of server and bandwidth [2].

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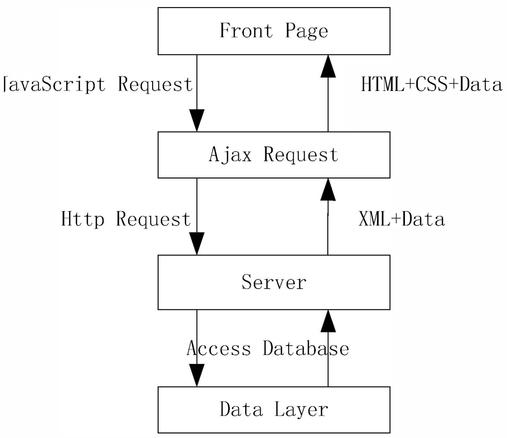

Figure 1. The Ajax workflow.

The XMLHttpRequest object is a core of Ajax for data exchange process between the client script and server. The greatest benefit is that you can update the part of the website content without the refreshing the entire page. By dynamically changing content to be displayed in the browser with DOM, Ajax enables browser-based applications more interactive and akin to traditional desktop applications. Ajax uses the browser internal object XMLHttpRequest to send and receive the Http request and response information, JavaScript to control and handle. Because JavaScript has a dynamic type characteristic, and XMLHttpRequest implementations are compatible on the different browsers, thus simplifying the development process.

IV. J2EE DATA PROCESSING BASED ON MVC

MVC is the abbreviation of Model –View–Controller design pattern, which describes a way to separate interaction of user and program and the work of completing other business logic parts well[3]. The MVC pattern was first proposed by the Smalltalk language research group to be applied to the user interaction process. View on behalf of the user interface, for Web applications, can be summarized as the Web interface. Model is to make business rules and deal with business processes/states. The business process is black-box operation for other layers. The Model receives the requested data of View, and returns the final processing results. The design of business model is arguably the most important core of MVC. Controller can be interpreted as receiving user requests, and completing it by matching the model and view together. The controller can choose different models and views to complete the various requests of user.

The Model, View and Controller's separation makes a model with multiple display views.

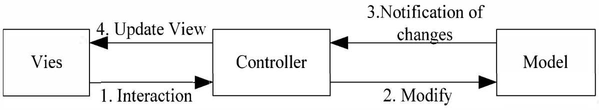

Figure 2. MVC Model.

Method of JSP + Servlet + JavaBean is usually used to realize the development of MVC framework in J2EE.

A. Implementation of View layer

View layer uses JSP pages to realize the collection of user data through a form.

B. Implementation of Control layer

User login page, for example. After the user fill in the data and submit the login request, the form will be submitted to the login Servlet by client browser. On the server side, Java program of processing the corresponding Servlet can be positioned by viewing the web.xml file. According to the above description, we can find the Servlet name of corresponding /servlet/login path is LoginAction, which is associated with Java program edu.hrbeu.ajax.servlet.LoginAction. Processing data from the JSP page to Java achieve the separation of the View and Model.

C. Implementation of Model layer

Model layer is the core module of the software for all the data are processed here, and it is responsible for the realization of all business functions of the software. Model layer is realized by JavaBean, including using it to process submitted data, and control or access to data in the database.

After JavaBean processing, data is forwarded to the JSP page and returns the results through Servlet.

From the description of the whole process we can find that, refreshing the entire page is a must while interacting through the way of submiting and returning results, it's not only consumes network bandwidth, but also increases the server load. Through continuous exploration, we found the following simple information interactive mode.

V. PROCESSING DATA BY AJAX

There are two ways that Ajax communicates with server: send requests by XMLHttpRequest object and process responses by JavaScript. The XMLHttpRequest object is a core of Ajax, which is used to implement the data interaction process between client script and server. The advantage of this technology is to provide a function that the developers retrieve data from the Web server without putting the currently browsing page of user back to it. This enables browser-based applications more interactive that changing the displayed content dynamically by DOM without refreshing the page when the browser updating the HTML content to display.

Ajax uses XMLHttpRequest, an object built into the interior of all browsers, to send and receive HTTP request and response messages. The letter A indicates "asynchronous", it means that the send() method of XMLHttpRequest object can return immediately, so that other HTML/JavaScript continues its browser-side processing on the Web page. The default request is performed asynchronously normally, you can also choose to send a synchronous request, but it will suspend the processing of other Web pages until this page has received a response from the server [4].

Before using the XMLHttpRequest object to send requests and process responses, you must create it by JavaScript first. The following codes as an instance of creating cross-browser XMLHttpRequest object by JavaScript.

```
//Creat XMLHttpRequest object
function creatXMLHttpRequest(){
    if(window.XMLHttpRequest){// Non-IE browser
        httpRequest=new XMLHttpRequest();
        }else if(window.ActiveXObject){//IE browser
         httpRequest=new
ActiveXObject("Micorosoft.XMLHTTP");
        }
}
```

XMLHttpRequest object provides a variety of properties, methods and events to facilitate JavaScript to process and control HTTP requests and responses.

XMLHttpRequest object typically call the open (DOMString method, DOMString uri, Boolean async, DOMString username, DOMString password) method to initialize an XMLHttpRequest object. The Post method sends data to the server and the Get method retrieves data from the server. The URI parameter is used to specify the XMLHttpRequest object to send the request to the server response URL. After calling open () method, XMLHttpRequest object set its readyStatus attribute value to 1, and reset the responseText, responseXML, status and statusText attributes to their initial values, it also reset request header.

Onreadystatechange attribute is called by XMLHttpRequest object to process the results returned. Onreadystatechange will trigger the event processor in each state change, a JavaScript function is called usually. The usage:

```
XMLHttpRequest.onreadystatechange=handleResponse;
```

First to check the status of request before processing a response, the function can handle the response only after receiving it from server completely. XMLHttpRequest provides the readyState attribute to judge the server response.

Values of readyState are shown in Table 1:

TABLE I. VALUES OF READYSTATE

Values	Statuses
0	Uninitialized
1	Loading
2	Loaded
3	Interacting
4	Completed

So only when readyState=4, which means a complete server response has been received, the function can handle the response [5]. Specific code as follows:

```
if (httpRequest.readyState == 4)
    { // complete server response is received }
else
    { // no complete server is received }
```

When readyState = 4, the function checks the value of HTTP server response status. The complete value can be found in the W3C document. When the HTTP server response status is 200, it means that the state is normal.

There are two ways to get data from server before processing data:

1) *Returning server response by the text string mode;*

2) *Returning response by the XMLDocument object mode.*

Ajax technology has a complete set of data processing, including data transmission request, server response, and client response. Meanwhile it maintains data in the premise of not updating the whole page, which makes Web applications more quickly to respond to user actions, and to avoid network to send information which is not changed.

Using a modified login page with changed submit button and adding the code for JavaScript processing:

```
<input type="button" value="login" onclick =
"userCheck()" />
```

The main JavaScript processing is as follows:

```
//Creat XMLHttpRequest object
var httpRequest;
function creatXMLHttpRequest(){
    if(window.XMLHttpRequest){// Non-IE browser
            httpRequest=new XMLHttpRequest();
    }
    else if(window.ActiveXObject){//IE browser
            httpRequest=new
            ActiveXObject("Micorosoft.XMLHTTP");
    }
}
//send request function
function sendRequest(url){
  creatXMLHttpRequest();
  httpRequest.open("GET",url,true);
  httpRequest.onreadystatechange=processResponse;//
Specify the response function
  httpRequest.send(null);
}
```

```
    //handle the returned information function

    function handleResponse(){

        if(httpRequest.readyState==4){//determine        the
object state

        if(httpRequest.status==200){//information has been
returned, start handling it

        var res=httpRequest.responseText;

         window.alert(res);

     }
        else {//the page is not normal
    window.alert("The requested page exception ");

      }

    }

}
```

The main part of information processing is integrated in Servlet:

```
   StringuserName=request.getParameter("userName");

   String psw=request.getParameter("psw");

   response.setContentType("text/xml;charset=gb2312");

   response.setHeader("Cache-Control","no-cache");

   //the following if statement can be placed in the
JavaBean as a model

   if(userName.equals("admin")&&psw.equals("admin")){

         out.println("Success");

     }

    else{

         out.println("Error");

    }
```

In the above process, complex processing procedures are usually putted in JavaBean model to achieve their specific functions.

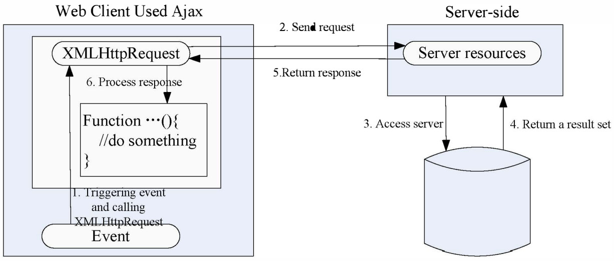

Figure 3. Ajax processing flow

In this process, create the XMLHttpRequest object first by clicking the login button. Then get the page information and send it to specified Servlet. Finally， processing the returned information and display the result by the prompt box, or modify the partial page contents through the DOM object.

VI. THE REALIZATION OF DATA ENCAPSULATED USING XML

When using Ajax for data processing, the method of responseText cannot easily handle bulk data, hence the data need to be encapsulated by XML.

The data need to be encapsulated into XML format before the server sending a response. For example, encapsulating the processed data in Servlet:

```
StringBuffer content=new StringBuffer("");
//set XML file format
response.setContentType("text/xml; charset=GB2312");
response.setCharacterEncoding("gb2312");
response.setHeader("Cache-Control","no-cache");
content.append("<?xml version=\"1.0\"
    encoding=\"gb2312\" ?>");
// add root node
content.append("<contents>\n");

…

//adding data results processed to the child node content

content.append("<content>\n");
content.append("<value>"+value+"</value>\n");
content.append("<text>"+text+"</text>\n");
content.append("</content>\n");
…
content.append("</contents>\n");

out.clear();//empty the output stream

out.print(content);//output XMLfile
```

The output XML file cannot contain the nodes whose content is empty, and it requires the charactor encoding are consistent and the format is accurate.

Client needs to parse out the data from the response file in XML format. At present, the mainstream browsers all support XML DOM specification. So we only need to use the standard JavaScript DOM object parse XML format file returned from the server [6].

```
var xmlDoc=xmlHttp.responseXML;// create XML object

content=xmlHttp.responseXML.getElementsByTagName("c
ontent");//get the label content array

…

//use content[i].childNodes[0].firstChild.data; to get the
contents of the note
```

Then putting the contents to be displayed in the string ta, using JavaScript function to modify the content of DIV label showdata to update the page, so as to achieve partial page refresh.

```
document.getElementById("showdata").innerHTML=ta;
```

VII. CONCLUSIONS

With the characteristics of Ajax technology, including fast response, high application efficiency, showing good results, saving bandwidth, etc., this paper designs and implements MT, to provide users with a comfortable and convenient operating experience. The advantages of Ajax are showed better in frequent data interaction and the complex Web applications. This paper uses XML data encapsulated to improve the Web data processing capabilities, and uses the DOM object to dynamically display the page content. The above research has more reference value for Ajax application development.

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