

Creating a Web-based Client/Server Network on Your PC: An Innovative Hands-on Training Model

Jensen J. Zhao

Zhao presents how educators can teach students to create a Web-based client/server network on personal computers to meet students' hands-on learning needs and the workplace demand. A step-by-step approach is presented with examples to guide students in (a) designing the network; (b) downloading and installing a Web server; (c) developing a Microsoft Access database; (d) writing a Web-based client/server application; and (e) testing and managing the network. Finally, Zhao indicates the implications of this hands-on training model.

With the explosive growth of consumer and business demand for global Internet, corporate intranets, and business-chain extranets, Web-based networks have been replacing the conventional local area networks (LAN) and wide area networks (WAN) as the mainstream of computer information technology. As Hamel and Sampler (1998) conclude, the Internet is not just another marketing channel; it is not just another advertising medium; it is not just a way to speed up transactions; it is the foundation for a new industrial order. The smartest companies and not-for-profit organizations are using the Internet/WWW to create a whole new way of doing business (see, for example, Brown, 1998; Cronin, 1998; Schonfeld, 1998). According to the 1998-1999 Occupational Outlook Handbook (Veneri, 1999), the expanding integration of Internet technologies by businesses has resulted in a rising demand for a variety of skilled professionals who can develop and support Internet, Intranet, and Web applications.

However, in traditional telecommunication and network training, hardware and software are often not available for students to have hands-on learning in developing and supporting networks. To solve the problem, this article presents how educators can teach students to create a Web-based client/server network on personal computers to meet their hands-on learning needs as well as the workplace demand. First, the Web-based client/server network is defined. Second, the objectives of this hands-on training model are stated. Then, a step-by-step approach to creating

and managing the network is presented with examples. Following this approach, students are able to create and manage a Web-based client/server network on their personal computers. Finally, the implications of this hands-on training model are discussed.

Web-based Client/Server Network on PC

A Web-based client/server network is a computer communication system, in which client computers send requests to the server computer for data from its database, and the server returns the results to the clients via Internet/WWW. The server can be set up on a Windows 95, 98, 2000 or NT computer connected to the Internet; thus, it can be accessed via Internet by any client computers around the world. The required software is a Windows 95/98/2000/NT Web server, which can be downloaded free at <http://www.winfiles.com/apps/98/servers-websrv.html> or <http://www.microsoft.com/windows/ie/pws/default.htm?/Windows/ie/pws/main.htm>. Therefore, teaching how to create a Web-based client/server network can provide students with a whole new array of hands-on training in computer networking and telecommunications.

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Objectives of the Hands-on Training Model

This model includes hands-on learning activities ranging from designing a network to installing, testing, managing, and supporting it. After completing this hands-on training project, students will be able to:

1. Design a Web-based client/server network.
2. Download and install a Windows 95/98/2000/NT Web server.
3. Develop a Microsoft Access database.
4. Write a client/server application with HTML and DHTML.
5. Test the Web-based client/server network.
6. Manage and support the network.

Creating a Web-based Client/Server Network

For students to create a Web-based client/server network on personal computers, the instructor needs to reserve a computer lab equipped with Windows 95, 98, 2000 or NT operating systems, Microsoft Access 97 or 2000, and the Internet connection. Then, the instructor can provide students with a step-by-step approach to achieving the hands-on learning objectives. This section describes in detail how to accomplish the first four steps of the hands-on learning activities: (a) designing a Web-based client/server network; (b) downloading and installing a Web server; (c) developing a Microsoft Access database; and (d) writing a client/server application.

Designing a Web-based Client/Server Network

A Web-based client/server network uses the Transmission Control Protocol/Internet Protocol (TCP/IP) for data communication. TCP/IP operates on Ethernet and Token Ring LANs, on various WANs, and even on customary telephone lines that are connected to a modem. Therefore, a well-designed Web-based network often does not require extra hardware except for the extra software—a Web server.

Microsoft Personal Web Server (PWS) 4.0 for Windows 95, which is downloaded free at <http://www.microsoft.com/windows/ie/pws/default.htm?/Windows/ie/pws/main.htm>, was selected for this hands-on training project. Once PWS 4.0 is installed on a Windows 95 computer, it turns the computer into a small-scale Web server for peer-to-peer or small group usage with a maximum of 10 concurrent connections. PWS 4.0 would enable you to teach your students, the future network developers or managers, not only how to publish Web pages on the Web servers, but also how to set up a Web-based, server-side database for client-side users to send and receive data via the Internet. In addition, PWS 4.0 is fully integrated into the Windows 95 Task Bar and Control Panel, making it easy to start and stop HTTP and FTP services whenever needed. Therefore, this desktop Web server is ideal for student hands-on learning activities such as developing, installing, testing, and managing the Web-based client/server network and Web applications.

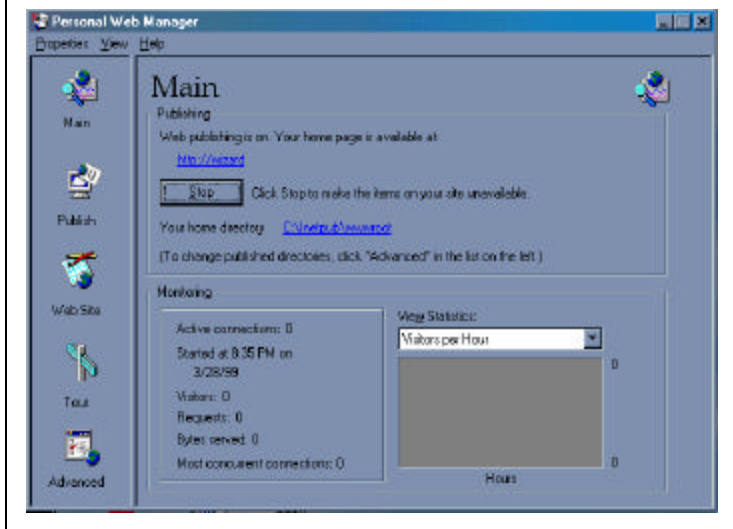
Downloading and Installing PWS 4.0 for Windows 95

The following steps illustrate how to download and install PWS 4.0 for Windows 95 on your PC:

1. Activate your Netscape Communicator or Internet Explorer 4.01 browser, then enter **<http://www.microsoft.com/windows/ie/pws/default.htm?/Windows/ie/pws/main.htm>** in the **Location:** box, and press **[Enter]**. You can also use **Search** at the Microsoft home page for Personal Web Server 4.0 for Windows.
2. Click **Download Microsoft Personal Web Server 4.0 for Windows 95** at the Download & Trial Center. Then, follow **Download Steps 1, 2, and 3** on the screen, click **download.exe** and save it in your computer's **My Documents** file folder.
3. When initial download is completed, open the **My Documents** file folder and double-click the **download.exe** file. Read the agreement; click **OK** to start downloading and installing PWS 4.0 on your PC.
4. Once PWS 4.0 is installed, you will find a new icon on the Windows 95 Task Bar. After you

click the icon, the Personal Web Manager of PWS 4.0 will be displayed as shown in Figure 1. If your computer was configured differently, you may need to take the following additional steps: (a) go to **My Computer, Control Panel, and Network**; (b) select **Add, Service, Add, Microsoft, Personal Web Server**, and **OK**.

Figure 1: The Main Window of Personal Web Server 4.0 for Windows 95



5. Now you need to create a new file folder at the **[C:]** drive of your computer as **C:\pws** for the new client/server application and database files you will develop in the next sections as well as for the virtual directory of the Web server.
6. The virtual directory can be created as follows: (a) double-click the PWS 4.0 icon to activate it, then click the **Advanced** icon; (b) be sure that **< home >** is highlighted, then click **Add**; (c) type **C:\pws** in the **Directory:** box, type **pws** in the **Alias:** box, then click **OK**.
7. Now the Web server, PWS 4.0, is installed on your PC and you are ready to publish Web pages on it. To have an overview of PWS 4.0, you can click the **Tour** icon on the Personal Web Manager of PWS 4.0 (see Figure 1). To create your home page with the PWS home page wizard, click the **Web Site** icon and follow the directions. You can also edit your

home page, view guest book, and open message-drop box by just clicking the respective hyperlinks. To publish new Web pages, click the **Publish** icon for directions. Be sure to publish or save your Web pages in the **C:\pws** file folder.

8. To allow you and your clients to visit your Web site on a browser, you need to provide your server's Uniform Resource Locator (URL), which consists of **http://< your computer IP address > /pws/filename.htm**. You can find your computer's IP address in this way: (a) go to **My Computer, Control Panel, and Network**; (b) select **TCP/IP**, click **Properties**, then click **IP Address** to find your computer's IP address, which is a number; and (c) write down the IP address for your server's URL. Now knowing your server's URL, you and your clients can visit your Web site on a browser anywhere and anytime as long as your server is on.

Developing a Microsoft Access Database

In order for your Web server to be dynamic and gather information from and send information to users, you need to develop and install a Web-based database on the server. The following steps indicate how to develop and install a simple Web-based Microsoft Access 97 or 2000 database:

1. Create a simple student class registration database with one table named "Student."
2. Create the field names of Student ID, Last name, First name, Class 1, Class 2, Class 3, Class 4, and Class 5 for the student table (see Table 1 for example).
3. Enter student IDs, names, and class registration information into the table.
4. Save the database in the **C:\pws** file folder as **C:\pws\School.mdb**.
5. For users to access data in this database from any Internet-connected client computer, you also need to write and install a Web-based client/server application on your PC.

Table 1: An Access 97 File for Student Class Registration Information

StudentID	Lastname	Firstname	Class 1	Class 2	Class 3	Class 4	Class 5
20001	Alex	Ryan	ACC201	MGT300	BL260	MKG300	ACC201
20002	Ball	Mark	ACC202	MKG300	ECON201	ACC202	BL260
20003	Carter	Sarah	BL260	ACC201	ECON221	ECON202	ECON201
20004	Dean	Rick	ECON201	ECON202	BEOA249	BEOA210	MKG300
20005	Eaton	Megan	BEOA249	BEOA210	MGT300	FIN350	BEOA249

Writing a Web-based Client/Server Application

This application consists of two Web files: (a) a request form written with HTML and (b) a result form written with DHTML. You can write these files with Web development tools such as Netscape Composer, Microsoft FrontPage, Visual Basic, NetObjects Fusion, Macromedia Dreamweaver, or write the files with HTML and DHTML by yourself on Windows Notepad, or use a combination of these tools. The following two sections show you how to write these files with HTML and DHTML.

Request form with HTML. Figure 2 shows the request form viewed with a Netscape Communicator browser. You can use a Web development tool to create this request form or write it with HTML on Windows Notepad as follows.

First, activate Notepad in the Accessories window, then type the following HTML file, shown in Exhibit 1.

After entering the HTML file, be sure to proofread it carefully, then select **File, Save As ...**, **Save in:** C:\pws, **Save as type:** All Files (*.*), and type **request.htm** in the **File name:** box and click the **Save** button.

The key part of this file is the fill-in form tag: `< form name= "request" Action= "Results.asp" Method= "POST"> ... < /form>` . The form gathers and sends the ID to the server for results from the Web database via the Active Server Pages (ASP) file:

Results.asp. If the ID is correct, the **Results.asp**, a DHTML file, will provide the respective student information as shown in Figure 3. If the ID is not correct, the result

form will respond so and ask to re-enter the correct ID.

Result form with DHTML. HTML is limited to writing static Web pages for only publishing or posting information. The interactive Web-

based client/server applications require dynamic Web pages with DHTML. You can build DHTML pages by using ASP as shown in Figure 3. ASP is an open, compile-free application environment that combines scripting, HTML, and robust database

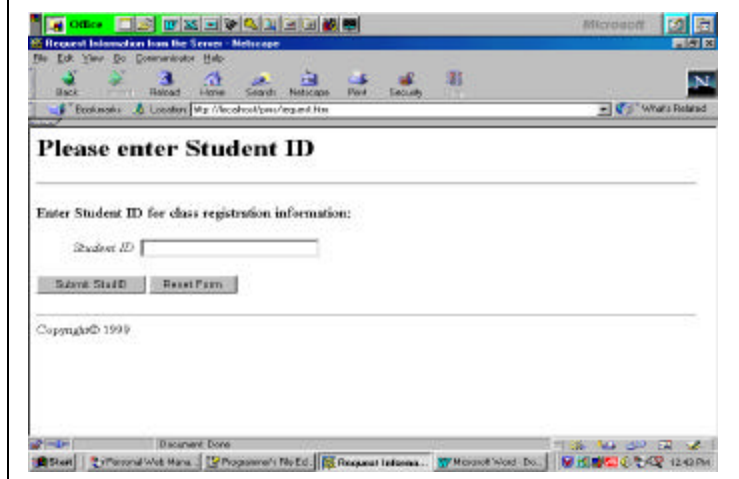
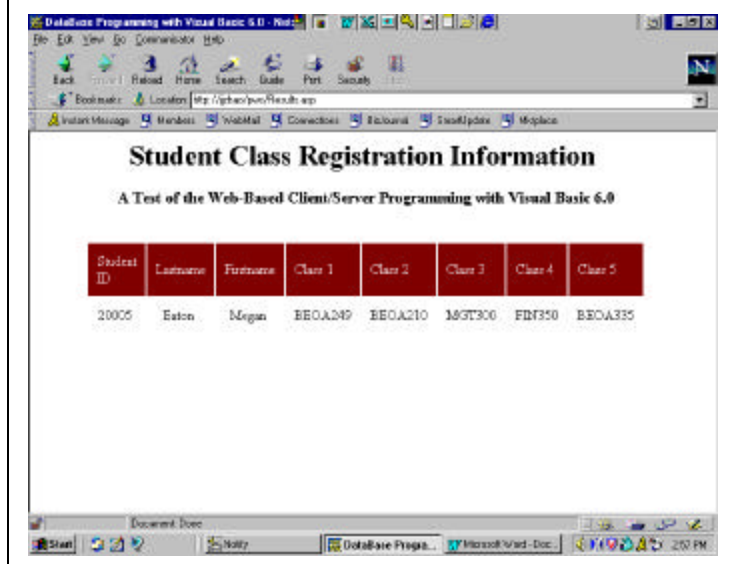
Figure 2: The Display of the Request.htm File**Figure 3: The Display of the Results.asp File**

Exhibit 1: HTML Code for request.htm File

```

< html>
< head> < title> Request Information from the Server</title> </head>
< body>
< h1> Please enter Student ID </h1>
< hr>
< form name= "request" Action= "Results.asp" Method= "POST">
  < p> Enter Student ID for class registration information:</p>
  < blockquote>
    < table border = "0">
      < tr>
        < td align= "right"> < i> Student ID </i> </td>
        < td> < input type= "text" size=25 name= "StudID"> </td>
      </tr>
    </table>
  </blockquote>
  < p> < input type= "submit" value = "Submit StudID">
    < input type= "reset" value = "Reset Form"> </p>
</form>
< hr>
< h10> Copyright© 1999</h10>
</body>
</html>

```

publishing for creating dynamic Web applications. You can use a Web development tool like Microsoft FrontPage 98 or 2000 to first build an HTML page, then insert server-side scripts, and finally save it as an **.asp** file. You can also use Windows Notepad or any other text editor to write the result form as shown in Figure 3 with DHTML as shown in the following exhibit:

When you have completed the file, be sure to proofread it, then select **File, Save As ...**, **Save in:** C:\pws, **Save as type:** All Files (*.*), and type **Results.asp** in the **File name:** box and click the **Save** button.

As shown in the foregoing ASP file, the delimiters `< % ... %>` are used to open and close script blocks of the file. These delimiters tell the ASP engine that everything between the delimiters belongs to the server-side scripting statements for the execution of data communication, not for browsing. Therefore, the script cannot be viewed as source code nor be copied from a client computer's Web browser. The If ...Then ... Else Statement within the delimiters `< % ... %>` is used for checking whether or not the submitted Student ID is correct.

Now you have completed the creation of the Web-based client/server network on your PC, and it is ready for testing.

Testing the Web-based Client/Server Network

Testing the network requires two steps: first, testing the network on the local host—your PC, and then, testing it at any client computers connected to the Internet.

Testing the network on your PC. To start with, double-click the Personal Web Server icon to make sure it is running. Second,

activate Netscape Communicator or Internet Explorer browser, and type **http://< your computer IP address> /pws/request.htm** (or **http://localhost /pws/ request.htm**) in the **Location:** box and press **[Enter]**. Next, the request form as shown in Figure 2 should be on your computer screen. If the request form does not show on the screen, it is possible that the request.htm file has coding errors or was not saved in the C:\pws file folder, which requires you to solve the problem. Fourth, if the request form is on the screen, you can enter a student ID, for example, 20005 in the box and click the **Submit StudID** button. Then, the result form as illustrated in Figure 3 should be on the screen.

If a wrong ID number was submitted, the screen would respond with this message: "Sorry!!! Student ID number was not found!!!" If a correct ID number was submitted and the screen shows a message like "... ADO could not find the specified provider..." instead of the result form, this means Microsoft.Jet.OLEDB.3.51 provider is not available on your PC. The Microsoft.Jet provider is a default database engine in Microsoft Office 97 and 2000

Exhibit 2: DHTML Code for results.asp File

```

< html>
< head> < title> Database Programming with Visual Basic 6.0< /title> < /head>
< body>
< center>
< h2> Student Class Registration Information < /h2>
< h3> A Test of the Web-Based Client/Server Programming with Visual Basic 6.0< /h3> < br>

< %
dim myConnection
dim rsTitleList
dim connectString
dim sqlString
dim requestStudID

connectString = "Provider=Microsoft.Jet.OLEDB.3.51; Persist Security Info=False; Data Source=C:\pws\School.mdb"

set myConnection = Server.CreateObject("ADODB.Connection")
set reTitleList = Server.CreateObject("ADODB.Recordset")

myConnection.open connectString

requestStudID = Request.Form("StudID")
sqlString = "Select * from Student where StudentID = " & requestStudID

set rsTitleList = myConnection.Execute(sqlString)

if (rsTitleList.bof) and (rsTitleList.eof) then
    response.write("Sorry!!!, Student ID Number " & requestStudID _
        & " was not found!!!")
else
%>

< table align = center Colspan = 14 cellpadding = 10 border = 0 width = 300>
< !- Begin column header row ->
< tr>
< td valign = top bgcolor= "#800000">
    < font style= "Arial narrow" color= "#ffffff" size = 3> Student ID< /font>
< /td>
< td valign = center bgcolor= "#800000">
    < font style= "Arial narrow" color= "#ffffff" size = 3> Lastname< /font>
< /td>
< td valign = center bgcolor= "#800000">
    < font style= "Arial narrow" color= "#ffffff" size = 3> Firstname< /font>
< /td>
< td valign = center bgcolor= "#800000">
    < font style= "Arial narrow" color= "#ffffff" size = 3> Class 1< /font>
< /td>
< td valign = center bgcolor= "#800000">
    < font style= "Arial narrow" color= "#ffffff" size = 3> Class 2< /font>
< /td>
< td valign = center bgcolor= "#800000">
    < font style= "Arial narrow" color= "#ffffff" size = 3> Class 3< /font>
< /td>
< td valign = center bgcolor= "#800000">
    < font style= "Arial narrow" color= "#ffffff" size = 3> Class 4< /font>
< /td>
< td valign = center bgcolor= "#800000">
    < font style= "Arial narrow" color= "#ffffff" size = 3> Class 5< /font>
< /td>
< /tr>

```

Exhibit 2: DHTML Code for results.asp File (Continued)

```

<!-- Get Data-->
< % do while not rsTitleList.EOF %>
< tr>
  < td BGcolor="f7efde" align = center>
    < font style = "arial narrow" size = 3> < %=rsTitleList("StudentID")%> < /font>
  < /td>
  < td BGcolor="f7efde" align = center>
    < font style = "arial narrow" size = 3> < %=rsTitleList("Lastname")%> < /font>
  < /td>
  < td BGcolor="f7efde" align = center>
    < font style = "arial narrow" size = 3> < %=rsTitleList("Firstname")%> < /font>
  < /td>
  < td BGcolor="f7efde" align = center>
    < font style = "arial narrow" size = 3> < %=rsTitleList("Class 1")%> < /font>
  < /td>
  < td BGcolor="f7efde" align = center>
    < font style = "arial narrow" size = 3> < %=rsTitleList("Class 2")%> < /font>
  < /td>
  < td BGcolor="f7efde" align = center>
    < font style = "arial narrow" size = 3> < %=rsTitleList("Class 3")%> < /font>
  < /td>
  < td BGcolor="f7efde" align = center>
    < font style = "arial narrow" size = 3> < %=rsTitleList("Class 4")%> < /font>
  < /td>
  < td BGcolor="f7efde" align = center>
    < font style = "arial narrow" size = 3> < %=rsTitleList("Class 5")%> < /font>
  < /td>
< /tr>

< %=rsTitleList.MoveNext%>
< %loop %>
< /table>
< /center>
< %End if %>
< /body>
< /html>

```

for data communication with Access 97 and 2000. Therefore, you need install the provider on your PC. You can also install the provider by installing Microsoft Visual Basic 6.0 on your PC. Once the provider is installed on your PC, you should be able to access data in the Web-based database on your PC via a Web browser.

Testing the network at client PCs. When the Web-based client/server network works on the local host PC, you can test the network at any client PCs with the Internet access as follows. First, activate Netscape Communicator or Internet Explorer browser on a client PC. Second, in the browser's **Location:** box, type **http://< your computer IP address> /pws/request.htm** and press **[Enter]**.

Then, the request form as shown in Figure 2 would be on the computer screen for you to enter a student ID and to get a result form as shown in Figure 3. Now you have successfully created a simple Web-based client/server network on your PC.

Managing and Supporting the Network

When the Web-based client/server network is running, skills of managing and supporting the network can be developed. Instead of having the **request.htm** file as the first page of the server, the instructor can teach students to create a homepage named "index.htm" for the server, which provides links to the request form, the personal pages such as

student résumé or profile, and other frequently used Web sites. Students can also update the class registration database by deleting and adding data. Furthermore, students can apply their learning from this project to expanding the network by adding other Web databases such as a students' grade book, a company human-resource system, and an on-line shopping center.

Pedagogical and Practical Implications

Teaching students to create a Web-based client/server network on their PCs has the following pedagogical and practical implications.

First, this training project provides instructors with an innovative approach to using the Internet and Web technologies for overcoming students' lack of hands-on learning in computer network development, installation, management, and troubleshooting.

Second, through this project, instructors can teach students how to use different tools to write a Web-based client/server database application with

HTML and DHTML and how to develop skills in decision making, problem solving, and trouble shooting.

Finally, learning through the project with innovative ideas and hands-on activities, students are able to develop and support other Web-based client/server networks and database applications for organizational intranets, extranets, and e-commerce.

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