New Media

[1] Web-Based Interactivity Using JavaScript

(Medical Education Web Page Series – Part 6)

JavaScript is a scripting computer language that allows one to add programming capability to your Web pages. It can be used for a great many purposes, but it is especially good in helping provide Web page interactivity.

JavaScript is different from Java, another popular programming language also often used in Web page projects. Java was developed at Sun Microsystems. JavaScript, on the other hand, was originally developed at Netscape. Microsoft's version of JavaScript is known as JScript. Both JavaScript and JScript are implementations of ECMAScript (ECMA262), the corresponding international standard.

Both JavaScript and Java are similar in so far as they both involve a technique known as Object Orientated Programming (OOP). In essence, object-oriented programming centres on the idea of user- and system-defined "chunks" of data, with a controlled means of accessing and modifying those chunks.

Object-oriented programming involves "objects", "methods" and "properties". An *object* is like a black box that stores some information. It may have a direct way for you to access that information as well as a way for you to save or change the information, but it may also have other less obvious ways of interacting with the object to obtain information. A Web page is an example of an object, as is any table, form, button, image, or link on the Web page.

Information associated with an object may require you to use a *method* to access it. The directly accessible information in the object are its *properties*. The difference between data accessed via properties and data accessed via methods is that with properties, you see exactly what you're doing to the object, while with methods, unless you created the object yourself, you just see the effects of what you're doing.

A Java "applet" (so-called because it's a small application) may run on a Web page, but is actually a fully contained program in and of itself. Java must be

"compiled" into what's known as "machine language" before it can be run. By contrast, JavaScript programs cannot stand alone; they must run within a Web page, and the Web page code must be run in a browser that understands the JavaScript language (most do).

JavaScript is not part of HTML, but is used in an HTML program. For instance, the following JavaScript statement will write a message on the Web page using a blue font:

```
document.write("<FONT  
COLOR='BLUE'>This is Blue Text</FONT>")
```

while this statement will cause a pop-up alert box to be displayed:

```
alert("<FONT COLOR='BLUE'>This Is  
Blue Text</FONT>")
```

JavaScript can be used for many applications, such as the following:

Providing Interactivity

As noted above, interactivity in Web pages can be provided by JavaScript to allow (for instance) users to enter answers to questions and find out whether their answer is correct.

Browser Detection

JavaScript can be used to determine which browser is used by a visitor coming to your Web page. Depending on the browser identified, a subsequent Web page designed specifically for that browser can then be loaded.

Cookies

Cookies are short messages or information given to a Web browser by a Web server. JavaScript can be used to store and retrieve cookie information on a visitor's computer; with appropriate JavaScript programming, this information can be retrieved automatically next time the user visits your Web page. This information can then be sent back to the server each time the browser requests a page from the server. The user's browser stores the cookie information in a text file called cookie.txt.

Control Browsers

JavaScript can be used to produce Web pages with customized windows, where one can programmatically specify the browser's buttons, menu line, status line or whatever else should be present.

Validate Forms

JavaScript can be used for validating inputs to fields before submitting a form to a server; an example would be validating an entered e-mail address to ensure that the address has an @ in the address.

Dynamic Text

JavaScript can put dynamic text into an HTML page. A JavaScript statement like this: `document.write("<h1>" + name + "</h1>")` can write a variable text (name) into the display of an HTML page, just like the static HTML text: `<h1>Crawford Long</h1>` does.

React to Events

JavaScript can react to events. That is, JavaScript can be used to execute a command when something happens, like when a page has finished loading or when a user clicks on an HTML element like an image or a hyperlink. Consider, for example, a clickable button whose definition includes the words `onClick="do_task()`. Here, the `onClick` event, as its name implies, will run the function `do_task` when the user clicks on the associated button. (Other events include `OnMouseOver`, `OnMouseOut`, `OnFocus`, `OnBlur`, `OnLoad`, and `OnUnload`.)

To use JavaScript in a Web page you will need to let the browser know in advance when you enter JavaScript code to an HTML page. This is done using the `<script>` tag. The `<script language="javascript">` and `</script>` tags are used to tell where the JavaScript code starts and ends.

Here is an example of a simple JavaScript program that puts a message on the computer screen:

```
<html>
<head>
<title>My First Javascript Project</title>
</head>
<body>
<script language="javascript">
alert ("Welcome to My First JavaScript
Project!");
</script>
</body>
</html>
```

The alert statement in the above example is a standard JavaScript command that will cause an "alert

box" to pop up on the screen. The visitor will then need to click the "OK" button in the alert box to proceed. A similar effect could also be achieved, but without using an alert box, by replacing the alert statement with the following:

```
document.write ("Welcome to My First JavaScript
Project!");
```

In this case the message would be integrated into the displayed Web page.

To achieve the same result in a blue font one would use this command:

```
document.write ("<FONT COLOR='BLUE'>
Welcome to My First JavaScript Project!
</FONT>");
```

Let's close with an example of a JavaScript program to enter pressures in units of cm H₂O and convert them to enter pressures in units of mmHg. This illustrates how simple it is to enter data using "forms" in JavaScript. The figure below shows how easy it can be.

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```
<html>
<head><title>Pressure Conversion Calculation</title></head>
<body>
<form
onSubmit="document.forms[0].elements[1].value=
document.forms[0].elements[0].value*.7356; return false;">
A pressure of <input size="10"> cm H2O is <input size="10"> mmHg.<p>
<input type="submit" value="calculate">
</form>
</body>
</html>
```

Top, User interface for a JavaScript program to convert cm H₂O pressure to mm Hg pressure. The user enters a number in the first box and clicks on the "calculate" button. The answer then appears in the second box.

Bottom, The JavaScript code required to achieve the above.

FIGURE Use of "forms" for data entry and output in JavaScript

[2] Call for Re-evaluation of Mobile Phones in Hospitals

Ever since the introduction of mobile (cellular) phones, there have been concerns that the signals emitted by these phones may interfere with electronic medical equipment such as monitors and infusion pumps, a phenomenon known as electromagnetic interference (EMI). Most hospitals in Canada have restricted the use of mobile phones in the hospital and consequently, communication within hospitals has never progressed far beyond ordinary telephone landlines and one-way pagers.

Any communications system within the hospital must achieve certain objectives such as low latency, high reliability, data security, and electromagnetic compatibility (EMC). As ordinary pagers are passive, non-transmitting devices, they cannot generate significant EMI and thus have no EMC problems. Data security is also not at risk as the content of the message is delivered via regular hospital telephone lines and is difficult to intercept. In addition, reliability is extremely high as the signal strength is strong throughout all areas of a hospital. With these advantages, it is easy to see why the numeric pager/landline combination has been the tool of choice for intra-hospital communications for decades. However, the pager is often less than adequate when it comes to latency issues.

Latency is the amount of time required between the transmission and reception of a message. Pagers have a high latency due to the number of steps involved in message handling. First, the sender must send the page. After a minute or more, the pager receives the message. Then the person who received the page must find a landline and call the number displayed, provided that the person is in the hospital and a landline is accessible. Only then, after minutes of delay, is the message delivered to the intended target. Of course, the description above assumes the ideal case. In reality, the latency can be much higher due to human factors. First of all, because the vast majority of pages sent are non-urgent, pages may be left unanswered for an extended period. While this may not be a problem in most cases, it does make the pager unsuitable in some emergencies. Secondly, a landline is not always accessible, especially considering that many hospital extensions cannot be reached directly from outside the hospital, which results in even more delays, as the person must reach the hospital switchboard first.

The ideal solution would be a fully integrated system, using multiple wireless technologies such as Bluetooth, wireless LAN, short-range wireless phones

as well as traditional telephones. Such a system was implemented in Mount Sinai Hospital in Toronto with great success.¹ However, the project required four years to complete and the equipment costs were enormous, not to mention the number of people required to build and maintain such a system. An affordable alternative has to use commonly available technology, such as digital mobile phones, and integrate them into the hospital.

Mobile phones, equipped with voice mail and text messaging/e-mail capabilities, could potentially alleviate most if not all of these problems. With mobile phones, the originator of the message can be in immediate contact with the person he or she is trying to reach, saving valuable time. Should the recipient be too busy to respond, a voice mail or text message can be sent, giving the nature of the message.

However, mobile phones come with their own set of problems. First of all, mobile phones must transmit data, bringing EMC into consideration. Traditional, analog cellular phones have been proven to interfere with a multitude of medical equipment such as monitors and infusion pumps.² On the other hand, modern mobile phones are digital devices that encode and send the audio as digital packets, reducing the likelihood of interference and making conversations much more secure. Also, medical equipment has greatly improved over the last few decades and is much less susceptible to interference from other devices. In a study published in the Mayo Clinic Proceedings,⁴ it was found that it is unlikely any serious malfunction of monitoring equipment would occur if a cellular phone was used at a reasonable distance of 5 feet or greater from the equipment.

There is also the matter of abuse. Once mobile phones are permitted in the hospital, personal calls will likely be made to and from these phones. In one incident, a complaint was filed against a surgeon in Hong Kong who was using his mobile phone during laparoscopic surgery done under local anaesthetic.³ The conversation was not about the patient, but the purchase of a new car. While such occurrences are probably uncommon, it does bring the problem into light and a policy must be established regarding the use of these phones for personal reasons. Finally, there's the problem of signal availability. In the basement of hospitals, the phone may be unable to receive calls. In addition, the user will not receive notification for any text messages or voice mail received until the signal has been reacquired. Signal repeaters must be installed to circumvent this problem.

Fortunately, the system is not impervious to change. Dr. A.C. Easty, Director of Medical Engineering at the

University Health Network, explained in an interview that intra-hospital communications had and will continue to change with technology. Although cellular phones were completely banned in the University Health Network in 1994, the policy was changed in early 2000 to restrict the use of mobile phones to areas outside patient care wards. He indicated that while analog devices have been known to cause interference problems, digital devices appear to be safe to use, although they will most likely remain restricted to use outside patient care areas until they have been proven to be safe. His vision of the future of intra-hospital communications involves a single, integrated device that combines the mobile phone, pager, wireless e-mail and personal organizer, using high frequency, low power, wireless technology that would be available as a consumer electronics item.

Unfortunately, such a device is not yet available, and although technologically feasible, it might be very cost-prohibitive. While it is likely that such devices will one day be issued to hospital staff much the same way as pagers are now, it is equally clear that this is unlikely to be realized in the immediate future. Given the low purchase and usage costs, the lack of substantial risk to patients' well being, the present availability, and the incredible streamlining of intra-hospital communications that would result, single-band, digital-only cellular phones should be considered as a practical replacement to the antiquated pagers and landline system.

One final note. We all know that cell phones are forbidden on commercial aircrafts. However, it's not the U.S. Federal Aviation Administration (FAA) that prohibits cell phone use in this setting - it's the U.S. Federal Communications Commission (FCC). According to a report in IEEE Spectrum Magazine⁵ "There's no proof that cell phone use does or doesn't interfere with navigational systems... the FCC doesn't allow cell phone use on airplanes because it wreaks havoc with ground telephone systems." This is because "airplanes travel so fast that cell phones used en route have to switch ground servers every few seconds and possibly connect to multiple towers at the same time ... and interferes with ground-based transmissions."

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