A Comparative Performance Analysis of Popular Internet Browsers in Current Web Applications

Boukari Souley, Amina S. Sambo
Mathematical Sciences Programme, Abubakar Tafawa Balewa University(ATBU), Bauchi, Nigeria
bsouley2001@yahoo.com +2348069667696 **+2348033512019**

Abstract

As more and more services become available on the Internet, the issue of fast and secured access to online resources gains more importance. The growth of the internet has encouraged a high number of people to explore and take advantage of the World Wide Web (www). The window to the World Wide Web is a web browser, hence the development of various web browsers in the market today. A comparative study of four web browsers namely Internet Explorer, Mozilla Firefox, Opera and Netscape was carried out. A web portal developed and fully tested was used to evaluate the performance of the four browsers. The results revealed that Mozilla Firefox and Netscape perform best in down load time, Internet Explorer performs best in memory usage, privacy and security, Mozilla Firefox and Netscape performs best in Page Layout, and Opera performs best in speed and performance.

Key words: World Wide Web, Internet Browser, W3C, APIs, Milnet

---

Introduction

The World Wide Web (WWW) is one of the most accessible parts of the Internet. Its ease of use allows people to perform tasks quickly and easily. But the creation of online shopping, banking, search engines, corporate websites and other personal services leads many users to pass information that should be kept private in an environment to which potentially everyone could have access. Web browsers attempt to present to user the best presentation they can offer and other options to facilitate better services on the web. Similarly, browsers also attempt to notify the user when applications are downloaded and try to execute on the user's machine. However, the result of various browsers based on some useful characteristics differs.

Though Web standards do exist, different browsers behave differently (in fact, the same browser may behave differently depending on the platform). Many browsers, such as Internet Explorer, also support pre-W3C APIs and have never added extensive support for the W3C-compliant ones[11].

Examples of web browsers include Netscape Navigator, Mozilla Firefox, Internet Explorer, Opera, Lynx, Enigma and so on. For browser compatibility, there are basic ways one can make a Web application extensible in order to add new browser support later.

In developing web applications, consideration must be given to possible browser differences; hence the developer should be informed about them. Following those guidelines not only allow your web applications to work in other browsers, but also on other platforms.

Web browsers are now an essential part of our daily lives. Many people use them to access e-mail, perform research, buy products and do other errands. Because web browsers are used for so many tasks, there are built- in functions to perform those tasks as well as to protect users from malicious content on the World Wide Web.

Generally, browsers react and display information differently and cross browser compatibility should be considered during web design. The World Wide Web contains

millions of web pages with a variety of different types of content.

The lack of awareness of available web browser and their characteristics, discourages many Nigerians from having access and enjoy faster access to vast mount of free information available on the internet.

A high volume of commercial activities occur on the internet not to mention free online resources that will enable research and empowering us with knowledge. Internet access and awareness are currently available in most part of Nigeria. Though bandwidth is restricted, Surfers should be aware of the browser options they have and select them based on their most important criteria.

For developers, the availability of a tool that performs the comparison helps to speed up the development time, assists them to become aware of the short comings, features and capabilities of each of the four web browsers. This reduces the time it takes to track down bugs in the web applications hence improves development time and application performance.

This study of web browsers becomes imperative to help serve as a educational and decision making tool for users. This study exploits on and explains the web browser characteristics of four web browsers from the various available web browsers.

Related Work

Brief history of the internet

The internet started as a project called the Advanced Research Projects Administration Network (ARPANET). It was meant to be both, an experiment in reliable networking and to link the American Department of Defense (DOD) with military contractors and universities doing military funded research. It was launched in 1969 and started connecting three supercomputers in California, U.S.A and one in Utah, USA. The success of ARPANET caused many universities to desire to be connected to the network [1]

This caused its growth and eventually it became hard to manage. It then split into two parts. MILNET, which catered for military sites only, and a new smaller ARPANET for non-military sites. Around 1980, the American National Sciences Foundation (NSF) decided to create five supercomputing centers for research use. The NSF created its own network NSFNET. By, 1990 almost all ARPANET traffic had been moved to NSFNET. In 1994, several large, commercial networks had been created within what is now called the internet. These networks grew beyond the borders of the United State and are today connected to almost all countries of the world. Other networks in other countries also linked up to create the internet, as it is known today [2].

In [3] internet is defined as a sprawling collection of computer networks that span the globe, connecting government, military educational and commercial institutions, as well as private citizens to a wide range of computer services, resources and information. A set of network conventions and common tools are employed to give the appearance of a single large network even though the computers that are linked together use many different hardware and software platforms.

A non technical definition of the internet as seen by an average internet user would be, "A virtual world assessed through computers and other devices. This virtual world modeled after the real world. This world now informally called 'cyberspace', has been evolving over the years and has continued to evolve..

Internet Services.

The internet offers many services to its users. The most popular services include E-mail, World Wide Web (WWW) and File Transfer protocol (FTP). Other less popular services offer access to other types of internet resources. These include Telnet, Finger and so on.

E-Mail

E-mail is the most popular internet service and it provides reliable means of communication worldwide. It consists of

information, usually text that is electronically transferred over telephone lines, fiber optic cables and satellite links, from a single sender to one or more recipients. Two pieces of information are needed to send e-mail messages over the internet - the recipients' user identification and the computer name to which the mail is to be sent. Simple Mail Transfer Protocol (SMTP) and Post Office Protocol (POP) are used to standardize the transmission format [7].

File Transfer Protocol (FTP):

This is a means of accessing files on a remote computer system, also called an ftp site. These files are stored in a tree like structures of directories. A connection is established with the computer system, the desired files are located and copied or downloaded onto the Users' hard disk. This allows information to be populated to the internet [9].

World Wide Web:

The WWW is the fastest growing internet service and it is treated as the future of internet navigational tools. It is a multimedia and hypertext system that allows pictures, video clips and sound to be included in text pages. The pages also have links to other pages that are displayed when the links are selected using a pointing device or keyboard. The WWW consists of documents called web pages and a collection of web pages on a particular subject matter stored on a single system from a website. The WWW uses the Hypertext Transfer Protocol (HTTP) to transmit web pages. Documents are viewed using software applications called web browsers[5].

Internet Browser and Characteristics

Mozilla Firefox : Mozilla Firefox (originally known as "Phoenix" and briefly as "Mozilla Firebird") is a free, cross-platform, graphical web browser developed by the Mozilla Foundation and hundreds of volunteers.

The features ***of Mozilla Firefox*** distinguish it from other ***web browsers*** such ***as Internet Explorer***, and are subject to both rave reviews and harsh criticisms. It lacks many features found in other browsers, in an effort to combat interface bloat and to allow the browser to be shipped as a small, pared-down core easily customizable to meet individual users' needs. Instead of providing all features in the standard distribution, Mozilla Firefox relies on the extension system to allow users to modify the browser according to their requirements.

Internet Explorer: Internet Explorer (IE) is the popular Web browser created and distributed by Microsoft. IE was first released in 1995, and IE has been the most popular Web browser since 1999 [6].

Internet Explorer has been designed to view the broadest range of web pages without major problems. During the heydays of the historic browser wars, Internet Explorer embraced Netscape by supporting many of the progressive features of the time. For a long period after the introduction of version six, there was no further development on the browser. Major development on the browser restarted in 2004 for Windows XP SP2 and continues in IE7 [4].

Netscape Browser: Netscape Browser is the name of a proprietary Windows web browser published by American Online, but developed by Mercurial Communications. It is a continuation in name of the Netscape series of browsers, originally produced by the defunct Netscape Communications Corporation[10].

While Netscape Browser's version numbers start at 8, it is based on Mozilla Firefox, whereas Netscape 6 and 7 were based on Mozilla Application Suite, itself a complete rewrite of the codebase developed in versions 1 through 4 - Netscape Navigator and Netscape Communicator. As with other recent versions, it incorporates support for AOL Instant Messenger, and other AOL-related features [3].

Perhaps the most noteworthy feature introduced in Netscape Browser is the ability to use either of two layout engines to render websites — either Internet Explorer's Trident or the Gecko engine used by Mozilla and its derivatives. This is used as part of the browser's "Site Controls" system, which allows security settings to be altered on a per-site basis, and is also touted as a defense against phishing and similar attacks, with both blacklists and white lists built in and automatically updated regularly. This system decides whether a site is "trusted" or "suspect", while only white listed sites use the Trident engine by default [8].

Other features highlighted by AOL's publicity include improved tabbed browsing capabilities, a toolbar system called the "MultiBar," which includes up to ten toolbars in the space of one, and extra support for "Live Content", such as RSS feeds. In keeping with the security emphasis, a new secure form information and password management system, known as a "PassCard," which saves usernames and passwords for individual sites, is also included[11].

Opera: Opera is a cross-platform web browser and Internet suite which handles common internet-related tasks including visiting web sites, sending and receiving e-mail messages, managing contacts, chatting online and displaying Widgets. Opera's lightweight mobile web browser Opera Mini and most current versions of its desktop application are offered free of charge[12].

Opera is proprietary software developed by Opera Software based in Oslo, Norway. It runs on a variety of operating systems including many versions of Microsoft Windows, Mac OS X, Linux, FreeBSD and Solaris. It is also used in mobile phones, smartphones, Personal Digital Assistants, game consoles and interactive televisions. Technology from Opera is also licensed by other companies for use in such products as Adobe Creative Suite[4].

Methodology

To successfully carry out an analytical comparison on these major web browsers, three major points have to be brought into consideration, namely - Performance, Usability and Security

Putting into consideration these three points, the comparison will be based on the following Criteria.

- **Download time:** How long it takes to load a web page
- **Memory usage:** The amount of memory each web browsers use
- **Page Layout/Image Display:** How each handle / displays a web page
- **Accessibility:** How each complies to the international accessibility Standards
- **Privacy and Security**[1]
- **Speed And Performance:** These includes:
    - Rendering Cascading Style Sheet (CSS)
    - Rendering table
    - Script speed**Ease of Setup:** How easy it is to install on a users computer

Another step is determining what others tried doing to get around the issue of unusable user interfaces. Studies of existing browser reveal that while the user may really want to use the most popular internet browser other browsers have better features but lack of awareness is restricting them[9].

A website that will allow for the comparison to be carried out was designed using the concept of web portal, JavaScript and Macromedia Dreamweaver as the development tool and HTML for the front end user interface.

Download Time

To make a proper comparison between both browers of how long it takes to download a specified web page**.**

Memory Usage

To effectively compare how much memory each web browser uses could cover two aspects.

a. How much memory is used when multiple windows are opened
b. How much memory is used when multiple tabs are opened

To achieve each, the windows task manager would be used. The Task Manager calculates and displays how much memory each currently running applications is consuming.

Page Layout / Image Display

To achieve this test, a web page is created that contains common HTML elements that are common to websites. The web page would also contain all the various image file formats in the industry today. This page is now viewed using the various web browsers and a comparison is made against each other.

The key points here would be:

a. How each layout and displays the web page
b. How each is able to handle, support and display the various image file formats in the industry today.

The results are compared and analysis made based on the outcome.

Accessibility

Web accessibility means that people with disabilities can perceive, understand, navigate, and interact with the Web, and that they can contribute to the Web. Web accessibility also benefits others, including older people with changing abilities due to aging[8]

This section would be based on already concluded test carried out by international communities that major on accessibility issue. The objective here is to determine to what extent each web browser implements the accessibility standards set by the international community.

The process would be as follows:

1. List out the major associability standards set by the international community
2. Determine to what extent each web Browser implements each.

Privacy and Security

This would be to determine how secure each web browser is. To achieve this, a web page would be created that contains the following elements.

a. Applets, Scripts and ActiveX Object
b. A link to download an external document
c. A link to execute an external program.

The essence of this test is to see how each of these web browsers secures the users from external third party programs from running on the host system.

Speed and Performance

The goal of this test is to determine how fast each of these web browses handles and executes various programs or instructions. The test would be carried out on individual web browser premises.

1. Rendering Cascading Style Sheets (CSS)

CSS which stands for Cascading Style Sheets, is the technology that make web pages look the way they look. It is a set of instructions given to a web browser to tell it how the web page is to be displayed, e.g. colors, font sizes, backgrounds etc.

The essence of this test is to find out how effectively the web browser executes sets of this instruction within each web browser[12]

Rendering table and Script Speed

Tables are a common feature in most web pages. This test procedure is similar to the earlier mentioned process. We load a web page that contains lots of table elements and determine how well and how long it takes each web browser to render the tables, then we compare results.

This test would determine the length of time it take for each web browser to successfully complete the execution of a certain set(s) of commands. Scripts are a vital part of the functionality and

interactivity of many web pages. The essence of this test is to see how reliable each web browsers in the execution of scripts.

Ease Of Setup

This test would require the installation of each of the web browsers in questions and determine how difficult or easy it was to successfully install the software on the user's machine.

Results can be taken from already carried out studies to save the user (supervisor) the hassles of having to uninstall and reinstall the web browser.

Run Tests.

Table 1: Scoring and Rating

Test	Score	Test	Score
Browser Info	*5 Points*	*ActiveXObject*	*1 Point*
CSS 1	*3 points (1 each)*	*Executable*	*1 Point*
CSS 2	*4 points (1 each)*	*Download*	*1 Point*
CSS 3	*2 Points*	Accessibility	*3*
	(1 each)		*Points(1 each)*
Graphics	*4 Points (1 each)*		
Card Layout	*5 Points*		

The RunTests first set the result display area to a default value of 0 (Zero), it then proceeds to call 8 (eight) other functions (TryCatch fucntion, Layer Movement, Random number engine, Math Engine, Dom Speed, Array Functions, String Function, Ajax Declaration)

Results and Findings

A web browser analysis tool was designed, fully implemented and tested to enable users make informed decisions about the use, installation and recommendation of the major web browsers considered in work. The tool was designed and implemented using industry standard technologies such as:

1. JavaScript Scripting Language
2. Hypertext Markup language (HTML)
3. Document Object Model (DOM)
4. Cascading Style Sheet (CSS)

The major Criteria used for comparison are: Download Time,Memory Usage, Page/Image Layout, Accessibility, Privacy and Security, Speed and Performance

Results

After testing on the various platforms, the Results obtained were summarized in Table 2 below:

Table 2: Result of each browser based on the criteria

	Internet Explorer	Mozilla Firefox	Opera	Netscape
Download Time	17 seconds	4 seconds	15 seconds	4 seconds
Memory Usage	6kb	523kb	726kb	233kb
Page Layout	12 points	16 points	15 points	16 points
Privacy / Security	3 points	2 points	2 points	2 points
Accessibility	1 point	3 points	3 points	3 points
Speed And Performance	CSS – 80 ms SCRIPT – 3876ms	CSS – 241 ms SCRIPT – 4917 MS	CSS – 60 ms SCRIPT – 2233 ms	CSS – 150 ms SCRIPT – 0 (*)

Discussion

Based on the results in the test run as shown in Table 2 above, the following observations have been made:

Download Time: Internet Explorer performs best, followed by Opera, Netscape and Mozilla Firefox presents the same performance.

Memory Usage: Opera uses the highest amount of memory available to the system, followed by Mozilla Firefox, Internet Explorer, in this test preformed best in the utilization of memory

Page Layout: Mozilla Mozilla Firefox preformed best in the presentation and implementation of graphics and CSS style definitions followed by Netscape, then Opera. Internet Explorer performed the least in this tests.

Privacy and Security: Internet Explorer gave the highest notification alerts to third party activities within the web browser. Others performed the same.

Accessibility: All the web browsers tested performed equally on this test except for Internet Explorer, scoring only a point.

Speed and Performance: The speed test was carried out on two premises.

1. **CSS Speed Test**: In this category, Opera showed a higher performance in executing CSS definitions, followed closely by Internet Explorer. Mozilla Firefox and Netscape, performed slower.
2. **Script Speed Test**: Opera also, in this test, performed better in executing the various JavaScript commands that where sent to the scripting engine. It is followed by Internet Explorer in performance then Mozilla Firefox. Netscape could not successfully execute the process, hence failed in the test.

Conclusion

A study of four internet browsers was carried out. A portal was designed that serves as a decision or intelligent tool for analyzing different web browsers. Depending on the browser on your system, the capacity of the system in terms of memory, speed and brand, results will be obtained for the criteria of comparison of browsers. This intelligent decision analysis tool will enlighten people on browser technology, possibility and finally will enable people to know which web browsers to use based on their various purposes. From the test results of the four internet browsers, a researcher would find internet explorer best because of its speed of download and security feature while a graphic programmer will find Mozilla Firefox more favorable because of its high performance of page layout.

References

[1] Vigil,B. (2002), Tech Target Security Media website. www.searchsecurity.techtarget.com

[2] Oppliger, R., (2000) ***Security Technologies for the World Wide Web.*** Artech House, Boston

[3] Raskin, J. (2000) ***The Humane Interface: New Directions for Designing Interactive Systems.*** Addison Wesley Longman, Inc, London

[4]. Tiwana, A..(1999) ***Web Security.*** Digital Press, Boston.

[5] Brian B.. (2004)***Browser Showdown Mozilla Firefox vs. Internet Explorer***

[6]. Rankin, (1997) ***Web browsers*** Addison Wesley Longman, Inc, London

[7] http://www.agnitum.com/news/securityinsight/december2005issue.php

[8] http://www.rnib.org.uk/xpedio/groups/public/documents/PublicWebsite

[9] http://www.aadmm.de/en/month.htm

[10] http://www.agnitum.com/news/securityinsight/december2005issue.php

[11] http://www.us-cert.gov/cas/tips

[12] http://en.wikipedia.org/wiki/Comparison_of_web_browsers