

IJACT 24-12-16

Web Standardization: An Overview

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Abstract

The Web has unique characteristics that distinguish it from products or software, so it is necessary to expand the concept of usability to include not only cognitive convenience but also emotional aspects and culture. Unlike software created with a clear intention by a single author or group, the Web is created by various authors with various purposes, so it requires various interactions between users and the system. Compared to existing software with few changes for system maintenance and updates, the Web is a dynamic system that continuously grows and changes. Unlike the relatively homogeneous and limited user group of software, the Web is used by users with various backgrounds and levels, making it difficult to provide unified training or control for the system. Since usability on the Web depends on how accurately and quickly users can access the information they want and how much aesthetic satisfaction and enjoyment they can provide, usability evaluations should be conducted in a different way from traditional software. Due to the diverse and constantly changing characteristics of the web from the basic environment to the end user, it is not desirable to apply software development principles and processes to the development of websites. Unlike the software environment, the Web does not have a defined user base, and unlike software, the tasks performed by users do not have a starting, middle, and ending stage, and they behave differently depending on their preferences. In this paper, we aim to provide an overview of web standardization in dynamic web environments.

Keywords: *Web Standardization, Web Usability, Web Accessibility, ISO, NIST*

1. Introduction

The Web has unique characteristics that distinguish it from products or software, so it is necessary to expand the concept of usability to include not only cognitive convenience but also emotional aspects and culture. Unlike software created with a clear intention by a single author or group, the Web is created by various authors with various purposes, so it requires various interactions between users and the system. Compared to existing software with few changes for system maintenance and updates, the Web is a dynamic system that continuously grows and changes. Unlike the relatively homogeneous and limited user group of software, the Web is used by users with various backgrounds and levels, making it difficult to provide unified training or control for the system.

The Web causes problems such as disorientation or embedded digression problems due to the vast amount of information and lack of structure. It is important to understand the unique habits and reactions of users so

Manuscript received: September 20, 2024 / revised: November 5, 2024 / accepted: November 25, 2024

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that the website can be designed and maintained more valuable, so that users will continue to visit it again. Due to the characteristics of the Web, in order to increase user satisfaction, efforts are needed to develop a website considering usability so that users can easily learn and use it efficiently. The biggest purpose of web usability evaluation is to evaluate a website from various aspects and continuously update it based on the results. In this paper, we aim to provide an overview of web standardization in dynamic web environments.

2. Overview of Web Standardization

The definition of usability varies depending on the researcher or purpose, but it can be broadly divided into usability in the narrow sense, which means how efficiently the desired purpose is achieved, and usability in the broad sense, which includes all elements related to the environment in which the system is used. When a system is easy to learn, easy to remember, has little mental burden, is highly effective in use, has high subjective satisfaction, and has few errors, it can be said to have high usability. Usability criteria are defined in terms of the criteria that allow users to be better, more efficient, and have fewer errors.

ISO 91261, which defines standards for the quality of software engineering products, initially defined usability as "a set of characteristics that require effort to use and a personal evaluation of use by authorized or closely related users"[1]. According to ISO 9241-11 [1], an international standard for usability, usability refers to the extent to which a product is made effective and efficient in helping users achieve their goals, and to ensure high user satisfaction. In the broad sense of usability, the quality experienced by users refers to the overall quality that includes the effectiveness, efficiency, and satisfaction felt by users when performing tasks through a system in various actual use environments including social, organizational, physical, and technical environments. ISO 9241-11 Guidance [1] on Usability defines usability as "the effectiveness, efficiency, and satisfaction of use in a specific context when a product is used by specific users to achieve a specific purpose." Usability is a complex concept that has measurement elements such as whether the customer has properly achieved the desired purpose (Useful) through an interactive product, whether such purpose has been performed as conveniently as possible (Usable), and overall satisfaction (Satisfiable).

Effectiveness, efficiency, and satisfaction defined in ISO 9241-11 are evaluated as whether appropriate functions that satisfy the corresponding measurement elements are provided, as shown in Table 1 below. ISO 9241-11 [1] suggests that usability testing should be applied as a methodology for measuring usability. Usability testing proposed in ISO 9241-11 [1] is a research methodology that discovers product problems and improvement requirements by observing and analyzing actual users using the product.

Table 1. ISO usability measurement factors

Element	Description
Effectiveness	Providing information/functions appropriate to the user's needs Stable and reliable product
Efficiency	Easy to learn how to use Products that reduce user errors
Satisfaction	Products that provide differentiated experiences Products that match the user's emotional tendencies

As shown in Figure 1, Jacob Nielsen [2-3] defined usability in terms of system acceptability, explaining it as a concept that constitutes usability and excluding functionality. System acceptability is distinguished into social acceptability and actual acceptability. Social acceptability is related to the favor or reputation of social groups for the system, and actual acceptability is distinguished by cost, reliability, compatibility, and validity. Among these, validity is distinguished into usefulness, which means how functional the system is, and usability, which means how well the system's functions can be used, and usability can be evaluated by actual users.

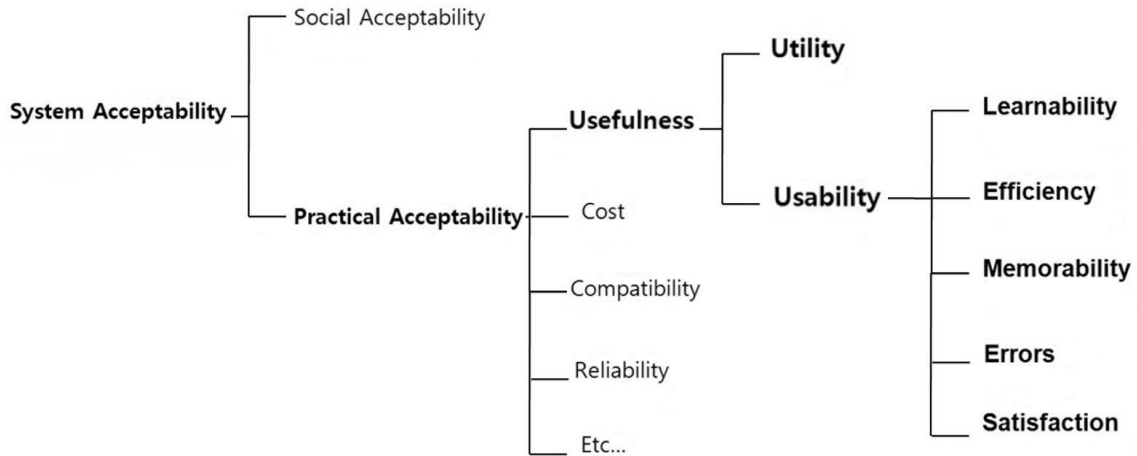


Figure 1. Jacob Nielsen's attribute model of system acceptance

Individual aspects of usability are called usability factors, and although the factors listed vary depending on the researcher, the five evaluation criteria suggested by Jacob Nielsen are the most widely used. Jacob Nielsen's usability principles [2] include the following items: learnability, efficiency, memorability, few errors, and satisfaction, as shown in Table 2.

Table 2. Jacob Nielsen's usability evaluation criteria

Criteria	Definition and Measurement
Learnability	This refers to the degree to which users can easily learn the system to perform tasks using the website, and is measured by the time it takes for a first-time user to perform a task
Efficiency	This refers to designing a website efficiently so that skilled users can perform higher-level tasks, and is measured by the time it takes skilled users to perform tasks that require specialized skills.
Memorability	This refers to the ease with which occasional users of the website can remember the entire function without having to relearn it, and is measured by the time it takes a user who has visited the website for a long time to perform a common task.
Errors	This refers to the number of errors that occur while using the website and the ease with which users can recover from mistakes, and is measured by the number of large and small errors that users make while performing a specific task.
Satisfaction	It means that you should be able to enjoy using the website so that you can be satisfied while using it.

3. Web Usability Guiding Principle

In the case of public institution websites, compliance with web standards and web accessibility guarantees

are mandatory, so efforts to comply with web standards and web accessibility are necessary. Ensuring web accessibility for public institutions has been mandatory since April 11, 2009, and compliance with web standards for e-government sites providing public services has been mandatory since 2011. In order to improve web usability, consideration of web standards and web accessibility should be given priority, and it is desirable to proceed in the order of quantitative usability evaluations to qualitative usability evaluations.

Web standardization refers to standard specifications and guidelines for various web-related technologies recommended by international standardization organizations such as the World Wide Web Consortium (W3C) and ECMA International. W3C [4-5] defines the potential of the Web in 7 points in the document "W3C in 7 Points" and is creating web standards as a means to bring out these potentials. The 7 potentials of the Web defined by W3C are in order of importance: Universal Access, Semantic Web, Trust, Interoperability, Evolvability, Decentralization, and Cooler Multimedia. The W3C website provides a standard CSS validation tool (W3C CSS Validation) and a standard HTML validation tool (W3C HTML Validation) that can verify in real time whether web standards are being followed. If you use the standard validation tool provided by W3C, you can perform validation immediately, and if the verification result shows that the web standards compliance rate is 100%, the W3C web standard certification mark can be posted on the website.

Developing a website in compliance with web standards enables web interoperability (cross-browsing) so that users can use the same web service regardless of their web browser. Cross-browsing can be verified by checking whether compatibility (all functions can be used without screen breakage) is possible in three or more browsers (Internet Explorer, Firefox, Safari, Chrome, etc.). Recently, HTML5, a standard proposed by the Web Hypertext Application Technology Working Group (WHATWG: Web Hypertext Application Technology Working Group) formed by web browser companies and web development communities, has been accepted by W3C and is actively being standardized as a next-generation web standard.

It ensures that any user (disabled, elderly, etc.) can access and use all information provided on a website without professional skills in any technological environment. Rather than creating a separate website for the disabled that provides limited services for content provided on existing websites, it is desirable to provide a text-only version. In 1997, W3C [4] established the Web Accessibility Initiative (WAI) to improve web accessibility for the disabled and announced the Web Content Accessibility Guidelines (WCAG) as a web accessibility standard. In 1999, WCAG 1.0 presented 14 guidelines and 65 checklists for web accessibility compliance, but there was criticism that it was unrealistic because it only considered HTML. WCAG 2.0, announced in 2008, presented 4 guidelines (principals), 12 guidelines, and 61 success criteria, and compared to version 1.0, it improved flexibility and testability, and strengthened the web usability aspect by reflecting new technologies.

Domestic web accessibility-related standard activities are led by the Web Accessibility Laboratory (WAH) of the National Information Society Agency (NIA), and in 2005, KWCAG 1.0 was adopted as the national standard. KWCAG 1.0 is a Korean-style web accessibility standard that was modified to fit domestic circumstances by referring to Article 508 of the US Rehabilitation Act and WCAG 1.0, and presents 4 guidelines and 13 guidelines. In 2009, the "National Standard Technology Guidelines for Improving Web Accessibility" was announced, which presented 18 indicators and specific development methods for the KWCAG 1.0 guidelines. In 2010, KWCAG 2.0 was revised as a national standard, which includes 4 principles, 13 guidelines, and 22 requirements. Using the Web Accessibility Verification Tool (KADO-WAH 3.0), you can check the level of web accessibility for the Korean Web Accessibility Content Guidelines (KWCAG) 2.0 items. The four design principles for web accessibility compliance are: (1) Perceivability (P): All content must be recognizable to users, (2) Operability (O): User interface components must be operable and navigable, (3) Understandability (U): Content must be understandable, (4) Robustness (R): Web content must be made robust enough to be accessible even with future technologies.

The National Institute of Standards and Technology (NIST) [6] proposes Web Metrics, a technical and quantitative measurement matrix for website usability. As shown in Table 3, Web Metrics is a checklist of guidelines for web usability that excludes subjective aspects and can be technically tested in HTML. The items presented in Web Metrics are items that can be identified in HTML source code at the current technology level, and cannot be considered items that must be checked to evaluate usability. Web Metrics largely classifies usability into six categories:

- Accessibility: Accessible to all users from all web browsers
- Performance: Website usage speed
- Navigation: Convenience of moving around the site
- Maintainability: Must be designed for easy maintenance.
- Readability: Scrolling should be minimal and distraction-free.
- Form Use: Forms should be easy to create and delete.

Table 3. NIST WebSAT evaluation guidelines

Criteria	Definition and Measurement
Accessibility	<ul style="list-style-type: none"> · All images that are not used as links must have ALT tags. · All images that are used as links must have ALT tags. · All Java applets must have ALT tags. · All image maps must have text anchors or links. · If frames are used, the noframe option must be present. · If colors other than the default are used, only RGB values are used. · The background color and TEXT color properties must always be specified in combination.
Performance	<ul style="list-style-type: none"> · The size of the page including the graphics must be less than 30K. · The image must include information about the width and height of the image. · The image must be in GIF or JPEG format. · The banner size must not exceed 468x60 pixels.
Navigation	<ul style="list-style-type: none"> · Every page should have at least one link. · Links should use the browser's default color. · Links should have appropriate descriptions. · Links should not be hidden. · Links should not open in a new window.
Maintainability	<ul style="list-style-type: none"> · Use relative links whenever possible. · Internal or external links should not be broken. · All pages should have a Head tag.
Readability	<ul style="list-style-type: none"> · Try to limit the density of your web pages. · Limit scrolling text, blinking text, and marquee style text on your pages.
Form Use	<ul style="list-style-type: none"> · Text entry forms should clearly indicate what information the user is asked to enter. · Users should know if a form is optional. · When users enter data, it should be presented to the user in the correct format. · If the form requires scrolling, there should be a 'Submit' or 'Clear' button at the top and bottom.

- Users should not be asked to fill out information that is automatically entered.
 - Forms should not use horizontal lines that interrupt the user's view or prevent additional scrolling.
 - Forms should include the function to complete and submit a completed form.
 - Forms should include the function to clear the form while it is being filled out.
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WebSAT (Web Static Analyzer Tool) is a quantitative usability evaluation tool that can measure how well it complies with NIST Web Metrics [6]. It is a software that analyzes the source of a web page and quantitatively indicates how many elements that help or hinder usability are included. The evaluation principles used in WebSAT are based on the usability guidelines presented in IEEE Std 2001–1999 (specifications in its P2001/D8.01 Draft). Web usability evaluation items require a lot of subjective and qualitative evaluation from users, and there are many areas that cannot be technically evaluated through software.

4. Conclusion

Since usability on the Web depends on how accurately and quickly users can access the information they want and how much aesthetic satisfaction and enjoyment they can provide, usability evaluations should be conducted in a different way from traditional software. Due to the diverse and constantly changing characteristics of the web from the basic environment to the end user, it is not desirable to apply software development principles and processes to the development of websites. Unlike the software environment, the Web does not have a defined user base, and unlike software, the tasks performed by users do not have a starting, middle, and ending stage, and they behave differently depending on their preferences. The concept of recent usability evaluation is developing beyond the perspective of simply verifying physical and cognitive usability convenience to a concept that includes users' emotions and culture.

Acknowledgement

This Research was Supported by Kangnam University Research Grants in 2023.

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