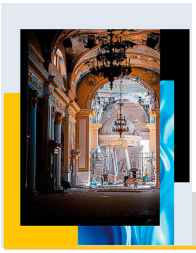

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Valeriy Bulatov*
Doctor of Philosophy in Design, Senior Lecturer
Ukrainian Institute of Arts and Sciences
08292, 14 Instytutska Str., Bucha, Ukraine
https://orcid.org/0000-0003-0832-2429

Features of aesthetics in the development of ergonomic web products for users with disabilities

Abstract. The study discussed the need to create an inclusive digital environment, where web products should provide equal access for people with different abilities, combining visual appeal, ergonomics, and accessibility for a full user experience. The purpose of the study was to analyse key aesthetic principles and design solutions that ensured visual appeal, comfort, and full accessibility of web products for users with various types of disabilities. The main research findings indicated that the aesthetics of inclusive web products were shaped by a harmonious blend of visual appeal, functionality, and accessibility. The study emphasised the importance of utilising a clear structure, logical navigation, and understandable interface elements to facilitate interaction for users with diverse disabilities. Key aesthetic and ergonomic principles and techniques have been identified, the application of which ensured the creation of accessible content within the context of inclusive web design. The necessity of ensuring sufficient colour contrast, design adaptability to various devices, and support for alternative information perception methods had been established. It was determined that consideration of the needs of users with disabilities contributed to a positive aesthetic experience and enhanced the overall quality of the web product. It was found that the impact of emotional response and social inclusion were important criteria for evaluating inclusive web products. Research has shown that design that made users with disabilities feel respected and included significantly improved their overall interaction and perception experience. The practical significance lie in demonstrating how integrating aesthetics is ensuring accessibility and delivering high-quality user experiences, thereby shifting web development from mere technical compliance to an inclusive design approach

Keywords: inclusive design; harmony; digital products; visual-design solutions; ergonomic principles

INTRODUCTION

Web products are important for equal access, yet many remain inaccessible to users with disabilities. True inclusivity goes beyond technical standards, requiring attention to aesthetics and ergonomic design for a positive user experience. Implementation of ergonomic principles through a systematic approach from design to testing is essential for accessible web design. While adhering to standards such as Web Content Accessibility Guidelines (WCAG) 2.1 (2025), was a good starting point, true ergonomics went beyond formal requirements and required a deep understanding of user needs. The standard emphasised that aesthetics and ergonomics were complementary aspects, and discussed key principles that had aesthetic manifestations, such as simplicity and clarity.

Researchers V. Klym & Yu. Tarasenko (2022) conducted an analysis of requirements effective in both European countries and Ukraine regarding the creation of informational web portals with ensured accessibility for people with disabilities. The authors presented key aspects of major international documents that established

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*Corresponding author

standards and recommendations for website accessibility for individuals with limited capabilities. The problem of web accessibility shortcomings for people with disabilities was investigated by S. Saripalli (2019), where the researcher emphasised not only the importance of applying the best standards, but also the necessity of ensuring accessibility for everyone, regardless of moral considerations. J. Pihavaara (2020) presented an analysis of the problem of implementing accessibility products in the digital design environment. The researcher examined accessibility integration processes as a system, identified factors that facilitated or hindered the implementation of accessibility among designers in Germany, and analysed how these factors can interact with each other. J. Chmal *et al.* (2022) conducted a study on the application of ergonomic principles to e-commerce web applications, noting that their implementation significantly improved user experience, increased conversion, and ensured accessibility for a wider range of consumers, including people with special needs.

N. Alajarmeh (2022) focused on the accessibility of a number of public health websites represented in 25 different countries, with the aim of identifying common trends and unique challenges in this field. Researcher examined how various types of disabilities (visual, hearing, motor, cognitive) affected the perception of and interaction with digital interfaces, and identified the main principles of accessible design as a foundation for creating ergonomic and user-friendly web products. A. Miller (2024) analysed the impact of accessibility on the emotional perception and comfort of users with disabilities. It was emphasised that inclusive design not only expanded the product's audience, but also contributed to increased loyalty, self-esteem, and user satisfaction, demonstrating the social responsibility and high level of professionalism of developers. B. Arias-Badia *et al.* (2022) presented key stages of the development, implementation, and evaluation of accessible products and services, focusing on inclusive design, emphasising the importance of considering the needs of people with limited ability from the very beginning of the design process.

Scientists M.V.R. Leite *et al.* (2021) provided an analysis of the state of mobile accessibility from the perspective of developers and companies. Researchers focused on five key aspects, such as: awareness; level of knowledge about standards and tools for creating accessible interfaces; frequency and methods of integrating accessibility principles into development processes; main reasons that motivate or do not motivate developers to create accessible products; barriers. H. Afuzova (2021) analysed the place of higher education in the context of European values of diversity and inclusion. The researcher examined how the principles of inclusion were integrated into the educational policies and practices of European countries, focusing on the need to transform education systems to ensure equal opportunities for all learners. I. Radionova (2025) analysed inclusive digital transformation from the perspective of its political dimension. The researcher outlined how public policy and governance influence digitalisation processes to make them accessible and consider the needs of all population groups. The research focused on the role of government in creating a legislative and institutional framework for inclusive digital services. The purpose of this study was to identify the features of aesthetics in the development of ergonomic web products for users with disabilities by analysing the relationship between aesthetics, ergonomics, and accessibility.

MATERIALS AND METHODS

The methodology of the research was based on a comprehensive approach, encompassing the following methods: systemic, analytical, cultural and historical, biographical, and generalising. Systemic method allowed considering aesthetics and ergonomics not as static phenomena, but as dynamic, interconnected categories in constant development and interaction, especially in the context of changing needs of web users with disabilities and technological progress. This approach enabled the analysis of contradictions between conventional notions of aesthetics and accessibility requirements, identifying ways to harmoniously combine them. Through the integration of the presented methods, the research topic was defined, its conceptual framework was clarified, and the exposition of the material was logically structured.

Applying synthesis, key European biographical principles were combined with Ukrainian studies in the field of aesthetics. These approaches were adapted to the academic requirements of both Ukraine and Europe, and their concepts were applied within the discourse of art history (Web Content Accessibility..., 2025; International Disability Alliance, n.d.). This method allowed the research to become holistic and to integrate into the established system of humanities. The generalisation stage included a brief description of the results, main conclusions, and plans for future research. The study was based on leading approaches. The hermeneutical approach was applied in the investigation of meanings and significances that users with disabilities ascribe to the aesthetics and ergonomics of web products. This allowed moving beyond superficial analysis and delving into the subjective experience of interacting with digital space.

Interdisciplinarity allowed for the combination of scientific principles of ergonomics with artistic aspects in the development of web products for users with disabilities. This was not merely a merger of two different fields, but a synergistic approach that enabled the creation of solutions that were not only functional, but also aesthetically appealing and intuitively understandable. This was because ergonomics traditionally focuses on optimising the human-system interaction, ensuring convenience, efficiency, and safety. The analytical approach was based on a vast number of literary sources, including the most promising research on this topic. This allowed not only to gain a comprehensive understanding of the modern state of the problem, but also to identify key trends and gaps in existing knowledge. Acording to a systemic approach, the topic was investigated and the combination of various methods allowed reaching

innovative conclusions. This integrated approach helped to identify patterns, develop unique solutions, and formulate recommendations that hold not only scientific value, but also practical significance for the development of inclusive and aesthetically appealing web products.

The paper analysed the design projects of websites, such as: 1) Top disability websites. From the focus on disability team (n.d.); 2) Remember the milk (n.d.); 3) Mobile app for people with disabilities (Sviryda, 2018); 4) International Disability Alliance (n.d.); 5) Disability Gateway (n.d.); 6) Asean Disability Forum (n.d.). These examples served as models for identifying and analysing key principles of inclusive design that combine aesthetic appeal with ergonomic functionality and accessibility for users with various types of disabilities. The analysis helped to: identify common features in visual design, such as high contrast, clear typography, and minimalist design, which contributed to easy perception of information; formulate practical recommendations for creating interfaces that were not only visually appealing, but also intuitive and convenient for everyone; confirm the importance of adhering to Web Content Accessibility Guidelines (WCAG) 2.1 (2025) standards as a basis for developing advanced and socially responsible web products.

RESULTS AND DISCUSSION

Contemporary web environments are increasingly populated by products designed with integrated accessibility for people with disabilities. This process transformed cyberspace from a source of frustration and exclusion into an inclusive environment, opening new opportunities for education, employment, communication, and self-realisation. But excessive visual complexity can become an obstacle to conversion. When a page is overloaded with elements, the user experiences cognitive overload, which leads to confusion, loss of interest, and ultimately, to closing the site. Conversely, excessive simplicity can create the impression of insufficient information or low quality (Matveieva, 2022). Through the purposeful integration of accessibility, digital platforms became more than just tools; they serve as bridges that overcome physical and sensory barriers, ensuring equal opportunities for all (Berdynskykh *et al.*, 2025). Design developed considering the needs of people with disabilities demonstrated respect and empathy. Research into the theoretical and methodological foundations of digital accessibility was extremely relevant, as advanced technologies perform universal functions, which contributes to the development of an inclusive society (Davydenko, 2023). The application of aesthetic and ergonomic principles in contemporary web product development is becoming an indispensable part of creating a high-quality and universal digital experience that catered to the needs of every user. A. Pakki (2024) noted that modern digital transformations largely depend on the development of AI technologies and Internet services, which contribute to the development of an inclusive intellectual space for a wide range of users. The development of software focused on the needs of users with various types of disabilities is a key tool for reducing the digital divide. Touch screens, voice interfaces and other inclusive technologies play a key role in ensuring the accessibility of the Internet for users with various types of disabilities. J. Pihavaara (2020) stated that digital products developed with inclusive design in mind included: websites, web applications, mobile applications, software, games, and other digital tools. These can be further categorised based on their aesthetic principles as:

- visual harmony, which includes: colour palette, typography, composition and layout, shapes and lines, iconography and illustrations, space;
- interactive aesthetics, comprising: animations and transitions, microinteractions (small, but noticeable visual or auditory reactions to user actions, such as a button colour change on hover, or a confirmation sound), feedback (how quickly and smoothly the interface responded to user actions, creating a sense of control and connection);
- auditory aesthetics, including: sound effects, background music (if present);
- emotional aesthetics, encompassing: identity and personality, mood and atmosphere, symbolism;
- unique style and branding (reflecting the product's individuality through unique visual solutions that enhanced recognition and user trust).

One of the key aesthetic characteristics in the development of ergonomic web products for users with disabilities is clarity and simplicity. An aesthetically appealing interface for users with disabilities is often minimalistic, free from unnecessary "visual clutter" (Fig. 1).

Figure 1. Website for people with disabilities

Source: Top disability websites. From the focus on disability team (n.d.)

A.J. King *et al.* (2019) emphasised that users form their first impressions of a web page almost immediately. This first impression determines whether users will stay on the site and whether they will want to visit it again. There were

gaps in the study of how objective design characteristics (e.g., visual complexity) affected the subjective perception of a website and users' first impressions. This implied clearly delineated elements, a coherent information hierarchy, large and easily readable fonts, and sufficient contrast between text and background. For individuals with visual impairments, for instance, aesthetic contrast is not merely visually pleasing, but is vitally necessary for element distinction. The deliberate use of a balanced yet visually harmonious colour palette, compliant with accessibility standards Web Content Accessibility Guidelines (WCAG) 2.1 (2025), transformed a technical requirement into an aesthetic component. Users' expectations of web design vary depending on the category of the site: they intuitively understand, what an online store, news portal, or educational platform should look like. Compared to university websites, which were often text-centric, e-commerce websites have a different visual structure. They display products in a grid format, contain minimal descriptive text, and offer users advanced search, filtering, and personalised recommendations. The web page's compliance with the user's desires regarding its visual style and structure make it highly prototypical, which positively influences perception and improved the user experience (Miniukovich & Figl, 2023). Furthermore, functional beauty served as another key element. Every design element, from buttons to navigation menus, must not only appear appealing, but also be intuitively understandable and convenient to use. For users with motor impairments, large interactive areas, ample spacing between elements, and predictable interface behaviour create an aesthetic of ease of interaction. This beauty manifested as convenience and the absence of frustration, enabling the user to achieve their desired goal effortlessly.

According to S. Saripalli (2019), the aesthetics of adaptability and flexibility are critically important. A web product must adapt to various assistive technologies (screen readers, magnifiers, voice control) without losing its visual or functional integrity. This implies that aesthetics are not limited to the visual layer alone, but extend to the semantic structure of the code, the application of ARIA attributes, and the ability to customise the interface to individual user needs (e.g., font size adjustment, colour scheme modification). When an interface empowers the user to control their experience, it fosters a sense of comfort and personal belonging, which constitutes a deeply aesthetic experience. The combination of ergonomic and aesthetic principles in the creation of contemporary web products has endowed them with the ability to be not only visually appealing, but also maximally user-friendly and intuitive. The main ergonomic principles in developing web products for users with disabilities include: perceivability, operability, understandability, robustness, and adaptability (Chmal *et al*., 2022).

During 2015-2025, a distinguishing feature of aesthetic solutions in web design has been the integration of artistic style elements such as minimalism, modern, retro, flash, and elegant, which enriched the user's visual experience, imbuing the web space with unique character and depth. For instance, the website presented in Figure 2 (a), exhibits a minimalist design. Ergonomic ease of information readability for visually impaired individuals was achieved through the use of humanist typefaces with low-contrast letter elements. The absence of excessive details in the designed website provided elegance and modernity, emphasising purity and functionality. The generous amount of "white space" surrounding all elements created a sense of "airiness", making the page visually lighter, reducing cognitive load, and allowing the eye to rest. This underscored a focus on content rather than decorative elements. Furthermore, the lack of unnecessary details on the page, specifically complex background images, shadows, gradients, or excessive visual effects, indicated that all elements served a specific function. Figure 2 (b) also showcased the design of an inclusive mobile application utilising elements in a modern style, which possessed a vibrant visual identity. One can observe the dominant saturated, contrasting colours – fuchsia and blue – which created an energetic, dynamic mood and attract attention. The choice of colours also contributed to better visibility of elements for users with visual impairments. Large, clear fonts, with an emphasis on the word "ABLE", highlighted the product's main idea and ensured easy information comprehension. The use of varying font sizes and colours created hierarchy and visual emphasis. The visual solutions accommodated the needs of people with disabilities – contrast, large elements, clear hierarchy, and a positive mood – contributing to broader audience engagement. Ergonomic aspects included clear information hierarchy, readability and contrast, and simplicity of navigation.

a

b

Figure 2. Design of digital products for people with disabilities

Note: a – minimalist design of the application "Remember the milk" by the company "37signals"; b – design of a mobile inclusive application using elements of the modern style

Source: A. Sviryda (2018), Remember the milk (n.d.)

The next example is the identity design developed for the Asean Disability Forum (n.d.), which featured elements derived from Modernist and Postmodernist design principles, specifically characterised by abstraction and symbolism. The developed identity is not a realistic representation but uses abstract forms to convey an idea. The elements employed are characteristic of Futurism, where movement is a central idea of the works. Thus, as can be seen in Figure 3 (a), the use of repetitive lines and blurred forms emphasised a sense of motion and speed. Simplified, abstract human forms make the identity understandable and ergonomic for a broad audience, regardless of cultural differences. This avoided specific depictions that might be exclusive. Furthermore, Figure 3 (b) presented the logo for a disability portal, designed with elements characteristic of geometric abstraction. Its abstract form avoided literalism, allowing it to be universal and not tied to a specific image. The use of contrasting combinations (red-green, blue-red) is often associated with positive emotions, hope, and cheerfulness. The contrast between the geometric shapes of the emblem and the softer, more rounded font in the "Disability Gateway" name creates an interesting visual dialogue. Ergonomic features include the use of a clear, modern sans-serif font. Such fonts are typically easy to read on screens and at small sizes. The absence of excessive decorative elements facilitates quick word recognition. The logo contains no small, complex details that could be lost, when scaled down, which is a crucial ergonomic requirement for digital media.

Figure 3. Interface designed with web accessibility in mind

Note: a – website design developed using elements of the artistic style "Futurism"; b –webpage is designed using elements of the artistic style inherent in geometric abstractionism

Source: International Disability Alliance (n.d.), Disability Gateway (n.d.), Asean Disability Forum (n.d.)

According to S. Kurt (2018), despite its transformative potential, the web space primarily serves those, who were already integrated into it, thereby creating significant barriers, especially in the realm of online education, for segments of the population facing various obstacles. In exploring this issue, the systemic causes hindering accessibility and outlined pathways for implementing effective solutions were identified. To achieve a complete and enjoyable user experience, researchers K. Fernandes *et al.* (2023) pointed out the need to integrate inclusive aesthetics into contemporary digital products and services. This involved not only functional accessibility, but also visual appeal and ergonomics, ensuring equal usability for all users, including people with permanent, temporary or situational limitations. It concerns creating visually appealing and intuitive interfaces that are pleasant to use, not just functional. Aesthetic decisions, such as font choices, colours, and layout, should consider the needs of different user groups without sacrificing beauty and contemporary design.

Y. Inal *et al.* (2019) analysed the awareness of user experience professionals (UX professionals) in Turkey regarding the concept of web accessibility. Integrating aesthetics and cognitive comfort into technical accessibility is the next logical step for UX professionals. Instead of viewing accessibility as a burdensome list of technical requirements, it should be perceived as an important component of overall ergonomics and design quality. Such an approach will help to move from perceiving accessibility as a mandatory, but burdensome set of rules to understanding it as an integral part of a comprehensive and enjoyable user experience. Accessible design required clear visual elements, and this is the basis of aesthetics that facilitated effective communication. For example, using sufficient colour contrast not only helped people with visual impairments, but also made the design more professional and legible for all users, especially on mobile devices or in bright lighting. On the other hand, good, intuitive design minimised cognitive load. If the site navigation was logical, the icons were clear, and the information was well-structured, users do not have to spend unnecessary effort to find the information they need. This approach made the experience comfortable not only for people with cognitive impairments, but also for any user, who values their time.

The study by M. Skierniewska & K. Skroban (2018) was a significant external research in the problem of software accessibility. However, analysis, which was based mainly on the Web Content Accessibility Guidelines (WCAG) 2.1 (2025) standards, can be expanded to integrate ergonomic approaches, allowing to move from purely technical aspects to a greater understanding of usability and efficiency. The study of how product design affected the user's cognitive processes, such as perception, memory, and decision-making. An accessible interface should minimise cognitive load. For example, overly complex navigation, illogical structure, or confusing terminology can create significant difficulties for the elderly or people with cognitive impairments, even if they technically meet the WCAG requirements. Assessing how the design interacted with the user's physical capabilities was especially important for users with motor impairments. Software should provide the possibility of effective use using various assistive

technologies and alternative input methods. B. Vollenwyder *et al.* (2019) examined key beliefs and perceptions that influenced developers and designers' willingness to consider web accessibility in their work. The researchers used the Theory of Reasoned Action to examine the attitudes, social norms, and behavioural controls that determined the intention to adhere to accessibility principles.

The conducted analysis of key aesthetic principles and solutions determined that the implementation of various aesthetic approaches in the development of ergonomic web products for people with disabilities significantly enhanced their effectiveness and memorability. The application of elements of artistic styles in creating the interface of web products was not a direct copying or imitation, but rather an interpretation of the key principles, aesthetic directions, and visual motifs inherent in certain art movements. This was explained by the fact that a visually well-thought-out and pleasant interface was not only better remembered, but also encourages repeated use, creating a positive user experience. Therefore, aesthetics in the development of ergonomic web products for users with disabilities extended beyond the traditional understanding of visual appeal. It encompassed clarity, simplicity, functional beauty, adaptability, and emotional satisfaction. This was design that combined visual harmony with impeccable accessibility, creating not just a convenient, but also an aesthetically perfect experience that allowed every user to fully interact with the digital world. This is a true manifestation of inclusive and humane design.

CONCLUSIONS

Aesthetics in design for people with disabilities was not secondary, but an integral part of ergonomics and accessibility. Well-thought-out aesthetics (colours, typography, composition) directly influenced the ease of perception, navigation, and overall comfort of use, which formed the basis of ergonomic design. In the course of the study, the specific influence of aesthetic practices used in creating a contemporary ergonomic web environment for users with disabilities was identified. The study revealed that aesthetic and ergonomic principles were closely interconnected, forming a coherent foundation for effective design. Their combined application ensured an optimal balance between functionality and visual appeal, which directly influenced the quality of user experience and enhanced the efficiency of developed solutions.

As a result of the study, it was determined that aesthetic decisions must be subordinated to the goal of maximum readability and clarity. This included a well-thought-out high contrast between text and background, colour combinations that considered the various impairments of users with disabilities. It also involved the use of humanist sans-serif fonts, adequate text size, and the minimisation of visual "noise". Aesthetics should not hinder functionality, but enhance it. Bright, yet not overly aggressive colours can create a positive impression and be associated with inclusivity. Aesthetic decisions must be adaptive, so that the product looks good and functions properly on various devices (desktops, tablets, smartphones) and with different assistive technologies. Well-thought-out aesthetics, combined with ergonomics complemented by functionality, was the key to creating effective, attractive, and user-friendly solutions. Key promising areas for further research are the development of quantitative metrics and models that will provide an objective assessment of the relationship between accessibility, aesthetics, and ergonomics. The proposed models, which will include specialised scales and questionnaires, will allow not only measuring technical compliance with standards, but also assessing visual appeal and overall user satisfaction, helping to identify the most effective design solutions.

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Валерій Булатов
Доктор філософії з дизайну, старший викладач
Український гуманітарний інститут
08292, вул. Інститутська, 14, м. Буча, Україна
https://orcid.org/0000-0003-0832-2429

Особливості естетики при розробці ергономічних вебпродуктів для користувачів з інвалідністю

Анотація. У дослідженні розглянуто необхідність створення інклюзивного цифрового середовища, у якому вебпродукти мають забезпечувати рівний доступ для людей з різними можливостями, поєднуючи візуальну привабливість, ергономіку та доступність для повного користувацького досвіду. Метою дослідження було проаналізувати ключові естетичні принципи та дизайнерські рішення, які забезпечують візуальну привабливість, комфорт і повну доступність вебпродуктів для користувачів із різними типами інвалідності. Основні результати дослідження засвідчили, що естетика інклюзивних вебпродуктів формується гармонійним поєднанням візуальної привабливості, функціональності та доступності. У дослідженні наголошено на важливості використання чіткої структури, логічної навігації та зрозумілих інтерфейсних елементів для полегшення взаємодії користувачів із різними видами інвалідності. Визначено ключові естетичні та ергономічні принципи й прийоми, застосування яких забезпечує створення доступного контенту в контексті інклюзивного вебдизайну. Встановлено необхідність забезпечення достатнього контрасту кольорів, адаптивності дизайну до різних пристроїв і підтримки альтернативних способів сприйняття інформації. З'ясовано, що врахування потреб користувачів з інвалідністю сприяє позитивному естетичному досвіду та підвищує загальну якість вебпродукту. Виявлено, що вплив емоційної реакції та соціальної інклюзії є важливими критеріями оцінювання інклюзивних вебпродуктів. Дослідження показало, що дизайн, який змушує користувачів з інвалідністю відчувати повагу й залученість, суттєво покращує їхню загальну взаємодію та сприйняття. Практичне значення полягає у демонстрації того, як інтеграція естетики забезпечує доступність і надає високоякісний користувацький досвід, зміщуючи веброзробку від суто технічної відповідності до інклюзивного дизайнерського підходу

Ключові слова: інклюзивний дизайн; гармонія; цифрові продукти; візуально-дизайнерські рішення; ергономічні принципи