https://www.sworldjournal.com/index.php/swj/article/view/swj32-01-024
DOI: 10.30888/2663-5712.2025-32-01-024

УДК 005.336.4:304-056.26:72

UX-ДИЗАЙН ЦИФРОВИХ ПРОДУКТІВ: ЗАБЕЗПЕЧЕННЯ ДОСТУПНОСТІ ДЛЯ ВСІХ КОРИСТУВАЧІВ

UX-ДИЗАЙН ДЛЯ ЦИФРОВОЇ ІНКЛЮЗИВНОСТІ: ЯК ЗАБЕЗПЕЧИТИ ДОСТУПНІСТЬ ДЛЯ ВСІХ КОРИСТУВАЧІВ

Kondratyuk A. S. / Кондратюк А.С.
UI/UX designer / UI/UX дизайнер
ORCID: 0009-0001-9623-9184
North Street Creative,
European University,
Kyiv, Akademika Vernadsky, 16V, 03115
Європейський університет,
Київ, Академіка Вернадського, 16В, 03115

Abstract. *Inclusive design is one of the most powerful and successful methods for improving the user experience for people of different backgrounds, identities, and experiences. The article is devoted to the formation and construction of logical chains in UX design for digital inclusion. Publications were reviewed that proposed ways to solve the problems of accessibility of UX design for all users.*

Inclusive design is an "advanced topic" in the field of UX design, in which there are many examples of inclusion. In the modern world of technology, the need to adapt digital products to different conditions of use is growing, which requires taking into account different physical, sensory, and cognitive capabilities. In the field of design, the beginning of a new decade means a greater emphasis on inclusive design. As a result, UX professionals in the IT sector are increasingly striving to design truly inclusive products and experiences. This approach not only removes barriers, but also ensures a comfortable use for everyone, simplifying access to information and functions, which is an important aspect of social equality. Inclusive design aims to create accessible and understandable products for all categories of users, including people with disabilities. This study presents an assistive design method to address this problem. It proposes a method to train a consistent representation for clustering TABs in software repositories based on their structure. A novice designer can input their pre-conceptualized structure to obtain design examples from TAB clusters of a software repository that have structures identical or similar to their concepts. Experimental results demonstrate the effectiveness of the method, achieving an accuracy of 66.7% and an F-1 score of 0.717, highlighting its correspondence to human clustering. This method not only increases the effectiveness of UX design for digital inclusion, but also helps to understand successful design practices in different contexts.

Key words: *UX design, accessibility, inclusive design, assistive technologies, visual user interface design.*

Introduction.

Inclusive design is a concept that focuses on creating products and services that take into account the needs of all users, including those with specific requirements or limitations. Typically, these can include visual, hearing, cognitive, motor, and other disabilities. It is important to note that inclusive design is not only about removing barriers, but also about creating a positive experience for all users so that everyone can

feel engaged and comfortable when interacting with the product [1].

Inclusive design is often confused with the concept of accessibility, but these two approaches have different applications. Accessibility involves adapting a product for people with disabilities, while inclusive design aims to create universal solutions that take into account the needs of all users, regardless of their physical, cognitive, or socio-cultural characteristics. There are many different frameworks for user-centered design, and they evolve greatly over time, but they all have one thing in common: they put the user first as a designer.

The approach to human inclusion began to change when UX designers realized that one-size-fits-all design did not meet the needs of every user. It was then that designers began to consider the concept of inclusive design, which focuses on developing solutions that meet a variety of needs. Therefore, inclusive design ensures universal accessibility for a wider range of users, allowing products to be not only functional but also comfortable for everyone.

Literature Review. The theoretical basis for the study of inclusive UI/UX design was the ideas and research of an inclusive approach to digital products, which were carried out by such specialists as Don Norman [2], Jakob Nielsen [3], Jeff Raskin [4], Alan Cooper [5], Jess Garrett [6] and others. In Ukraine, O. Boyko [7], S. Petrukha [8], N. Petrukha [9], G. Ryzhakova [10], V. Malikova [11], V. Pokolenko [12] have been dealing with the issues of implementing UI/UX design in educational practice and management with an inclusive bias.

With the advent of the graphical user interface (GUI), researchers such as Jonathan Gribben and Jakob Nielsen began to explore ways to improve user experience through visual elements, which gave rise to modern UI design [13]. Nielsen, in his studies [3, 15], focused on the importance of usability and clarity of interfaces, which laid the foundation for the further development of the industry [14]. Bai et al. [16] introduced UIBert, which transforms a single UI image into a sequence of objects that encapsulate different visual and textual properties. Their unique masking prediction algorithm helps to obtain a complete representation of the user interface. Banerjee et al. [17] also used visual and textual features of all user interface elements. A significant

contribution to the development of digital product design was made by Steve Jobs, who preferred simplicity and elegance in the design of Apple product interfaces. His approach was aimed at minimalism, reducing the number of elements and providing convenience for users regardless of their experience.

Research aims is to analyze the use and justify the prospects for developing UX design for digital inclusion.

Results.

UI is a set of all the elements through which a user interacts with a digital product, such as a mobile application or website. Historically, UI design evolved with the first computer interfaces in the 1980s, when users had to enter commands through text terminals. With the development of mobile technologies in the 2000s, UI design moved to a new level. The emergence of smartphones with touch screens has significantly changed the principles of building interfaces. Today, UI development continues to evolve, taking into account the latest advances in machine learning, artificial intelligence, interactive animation, and the need to adapt to different platforms and devices, such as smartwatches and other wearable technologies.

Inclusive design refers to the creation of design solutions that take into account personal characteristics such as ability, race, economic background, language, age, and gender [18]. Researchers and designers from traditionally marginalized groups are involved in the inclusive design process, so they can make their unique contributions at all stages of the design process. If universal design is a one-size-fits-all approach, then inclusive design can be described as "solve for one, extend to many." When people solve for one type of user through inclusive design, the benefits of that solution can be extended to many other types of users.

For example, when creating an inclusive UX design, more attention is paid to the needs of people who are blind or deaf than those who rely on their sight or hearing to communicate. Then, when they create new versions of the product, they design for those populations that are left out, such as people with physical or cognitive disabilities. Inclusive design covers several aspects, including accessibility. Accessibility refers to the process of making products, gadgets, services, or places accessible to people with

disabilities. However, designers should remember that the concept of "solve for one, extend to many" primarily benefits the target audience of the design and existing users. Many groups are not yet included. Over time, UX designers have realized that inclusive design is not always enough, and UX designers have reached a point where equality-focused design is becoming the new goal of the industry.

When people think of assistive technology, computers, tablets, and smartphones come to mind. However, AT encompasses a wide range of devices, including prosthetics, pointing devices, electric wheelchairs, powered lifts, gaze tracking devices, head tracking devices, and much more. The UX design process should take into account how people with disabilities will use the product. For example, the contrast of colors on the screen is increased by modifying the color, such as high contrast mode or dark mode on the device. High contrast can be seen in black text on a white background or white text on a dark background. The high contrast of the interface makes it easier for people with low vision to view. Anyone who suffers from eyestrain when viewing displays in the dark or at midday when the sun creates intense blinding light can benefit from color change. It is used by many people simply because it is easier on the eyes.

Next, let’s move on to voice control and switching devices. Both of these devices help people with limited dexterity and can be used in place of a keyboard or mouse. Voice control allows users to navigate and interact with the buttons and screens of their devices solely by voice. This feature is available on a variety of devices. A switch is an assistive technology that acts as a computer keyboard or mouse. Users can use switch devices to control technologies such as a computer or smartphone. Switching devices come in many different shapes and sizes, but they all help people with limited motor skills to use technology with ease.

Next in line are screen readers. Screen readers are one of the most commonly used assistive tools for people with limited vision. The software is compatible with mobile and web devices and reads any text on the screen out loud. Screen readers also interpret invisible text such as button names and alt text for images, as well as any interactive elements such as buttons. Alternative text (also known as alt-text) helps to transform a

visual user interface into a textual one. It essentially uses words to describe any relevant visual element to someone who cannot see it. Alt text is also quite useful for people with slow internet connections. If the device can't maintain an internet connection, it may have trouble downloading a large file or image. When an image does not load, alt text provides context.

People don't have to be disabled to benefit from assistive technology. A good example is speech-to-text. The user creates text using speech-to-text by speaking into a phone or computer. The voice recording is automatically converted to text. Many people find it much easier to text while talking to their device, as it eliminates the need for hands-free and minimizes the amount of mental energy required to type.

Therefore, for people with disabilities, authors propose using the top program bar (TAB) at the top of the mobile application screen, which is important for navigation and text display [19] (Fig. 1). It allows users to access different pages and shows their current location in the application. The TAB contains important buttons and status information, such as search, settings, and notifications, which increases efficiency and user experience. A well-designed TAB improves the usability and accessibility of the app for people with disabilities.

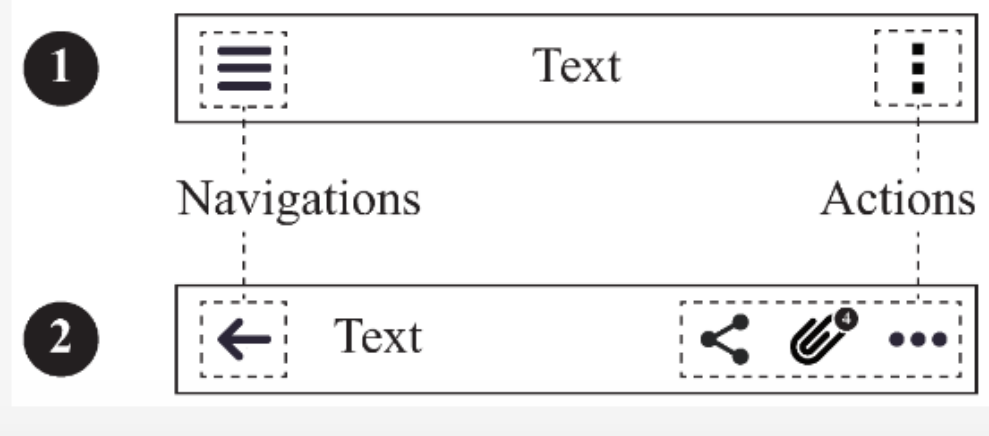

Figure 1 - Two types of TABs, as outlined in the Android design guidelines for people with disabilities

Designing a well-designed tab (TAB) (Fig. 2-3) for people with disabilities is especially challenging for novice designers. Beginners often find it difficult to

understand current design trends and practices. The rigid design may not match the functionality and content of the page, making it difficult to create an intuitive and aesthetically pleasing layout. Limited tab space requires careful selection and prioritization of elements, which can lead to overcrowding or omission of important components. Providing sufficient information and functionality in this limited space while maintaining simplicity and usability requires careful planning. It can also be difficult for novice designers to create a tab that is accessible and usable for most users. Achieving a design that meets user behavior patterns and expectations often requires considerable experience, trial and error, and user feedback [20]. Therefore, designing a tab for people with inclusion requires strategic thinking, user-centered design principles, and technical skill, which poses a significant challenge for beginners.

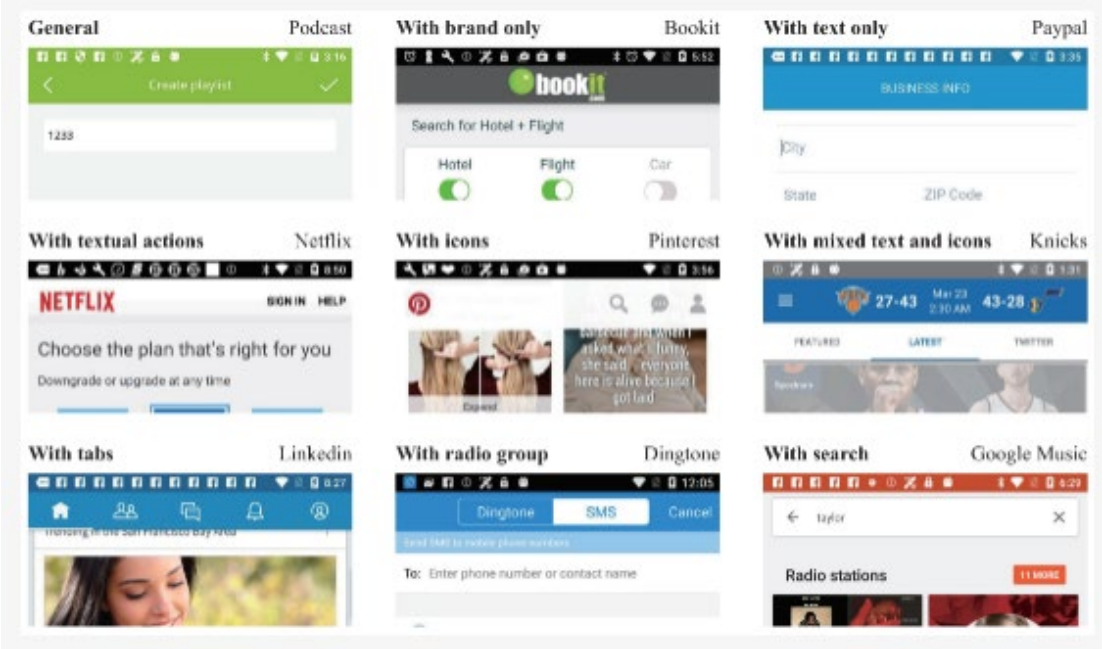

Figure 2 - Different variants of TAB for people with disabilities

Software repositories are a valuable resource for designers, offering rich examples of design for people with inclusion. Access to various existing designs helps beginners understand design elements in different contexts, forming a solid foundation for their projects. By studying successful examples, newcomers can learn the basic principles of layout, functionality, and aesthetics while avoiding common mistakes. Additionally, looking at a variety of designs can inspire creativity in novice designers, allowing them

to adapt and innovate. This reduces the time and effort spent on repetitive tasks, allowing designers to focus on customization and improvement.

This paper proposes a proof-of-concept method for automated extraction of design patterns for TABs from software repositories. Authors propose to develop a sequential tokenization that captures the linear characteristics of TABs. The tokenized TAB sequences can then be represented as vectors using a self-learning system. Clustering techniques are then applied to these vectors to identify inherent design patterns.

The first major challenge is cost. People may not be able to buy expensive phones with large screens and large amounts of memory. The next challenge is connectivity. Users may not have constant or unlimited access to the Internet. People with disabilities may not be familiar with certain design patterns, calls to action, and iconography that they take for granted. They may not know what a swipe means in the context of a touchscreen, for example. They may not even know that a touch screen exists. This can affect their confidence and willingness to experiment with new technologies. The final point to consider is literacy in general. Some users are unable to read, while others may need to switch languages depending on their goals.

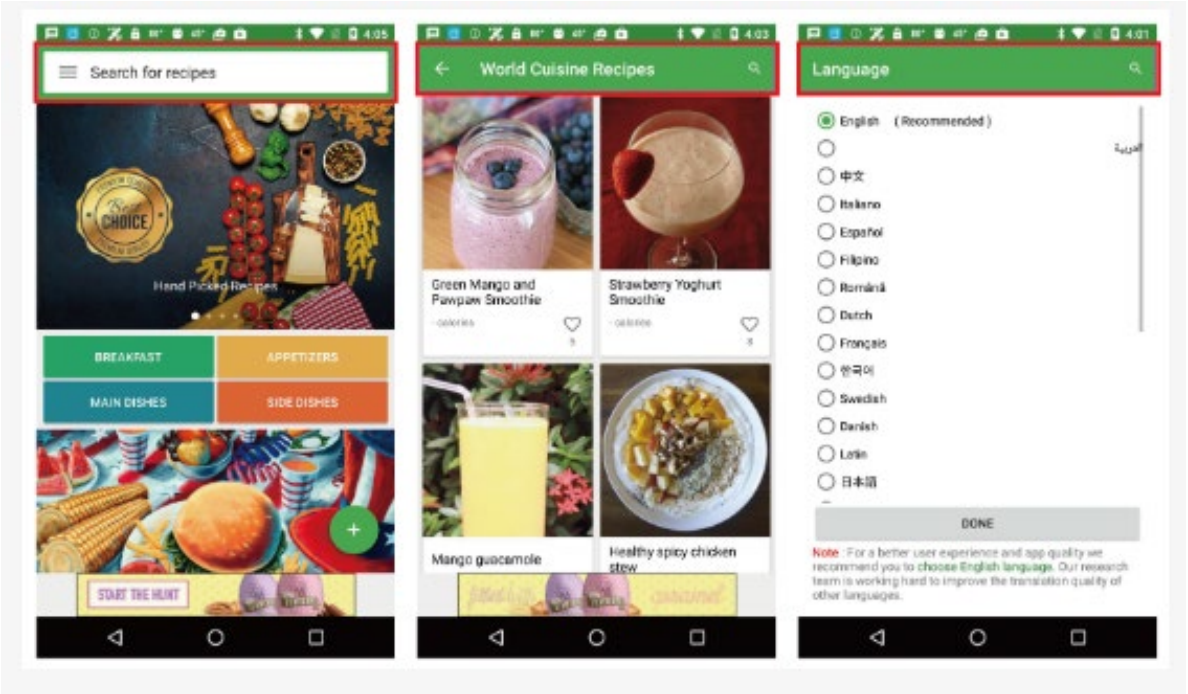

Figure 3 - Different tabs (in red boxes) in one program

Let's take a closer look at each of these four issues. Let's start with the price. People with fewer resources, for example, are more likely to buy cheaper gadgets with limited RAM. When the phone's RAM is low, it means that web pages will load more slowly and customers will have trouble downloading. The corporation is unlikely to lower its regular price to solve this problem. Instead, it's up to us, as UX designers, to figure out how to improve the storage without raising the price. One way UX designers and programmers can achieve this is by allowing users to temporarily pause apps. Fig. 4 shows the experimental design workflow, detailing the steps of data preprocessing, experiment setup, annotation, and formulation of evaluation metrics.

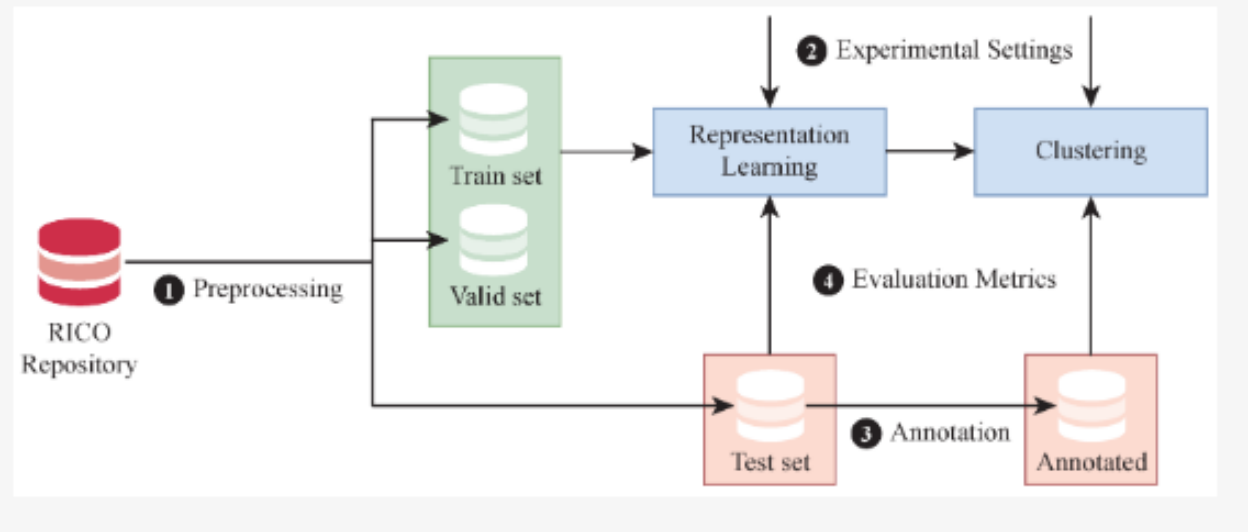

Figure 4 - Overview of the experimental design

User interface designers should look for ways to make offline experiences as rich as online ones. Allow customers to watch videos offline and ensure that this feature and experience is well designed. However, it is worth noting that some users with disabilities may not know how to operate a phone, download an app, or create an account. They may only use parts of the app that they are already familiar with, and if there are no clear instructions, they may stop using the app altogether. It is important to keep it simple, as some users with disabilities cannot read or type. Designers may consider using video tutorials to help new users learn how to install and use the app and feel more confident exploring new features.

Conclusion.

Thus, modern design requires taking into account not only the aesthetic design, but also the characteristics of a wide range of users, including those with limited cognitive or physical abilities. This implies applying the rules and principles of inclusive design, which are aimed at creating products that are easily accessible, regardless of individual needs. It's good to start with a deep understanding of the user's context, and for a UX designer, this is the first step in the field of inclusive design.

References:

1. QUERINI, V., What is inclusive design? A beginner’s guide [online]. 2021. URL: https://careerfoundry.com/en/blog/ux-design/beginners-guide-inclusive-design/

2. Norman D. The Design of Everyday Things. New York : Basic Books, 2002. 272 p.

3. Nielsen J. Designing Web Usability: The Practice of Simplicity. Berkeley, CA : New Riders, 1999. 432 p.

4. Raskin J. The Humane Interface: New Directions for Designing Interactive Systems. Boston, MA : Addison-Wesley, 2000. 233 p.

5. Cooper A. About Face: The Essentials of Interaction Design. - Wiley, 4th edition, September 2, 2014. 720 p.

6. Garrett J. J. The Elements of User Experience. - Berkeley, CA : New Riders, 2010. 304 p.

7. Pavlenko, I., Boiko, O., Mykolaiets, D., Moskalenko, O., & Shrol, T. (2024). Advancements in STEM education and the evolution of game technologies in Ukrainian educational settings. Multidisciplinary Reviews, 7, 2024spe007. doi: 10.31893/multirev.2024spe007

8. Petrukha S., Stakhov B., Petrukha N. Ukraine’s public finance: denerminants, institutional transformation and directions in development of budgetary regulation. Pandemic economic crisis: challenges to society. Sofia, Bulgaria : VUZF Publishing House “St. Grigorii Bogoslov”, 2020. P. 271–301. URL: https://philarchive.org/archive/BRIPEC-3

9. Ryzhakova G., Petrukha S., Petrukha N., Krupelnytska O., Hudenko O. Agro-Food Value Added Chains: Methodology, Technique and Architecture. Financial and Credit Activity: Problems of Theory and Practice. 2022. Volume 4 (45). P. 385–395. DOI: https://doi.org/10.55643/fcaptp.4.45.2022.3809; URL: https://fkd.net.ua/index.php/fkd/issue/view/61

10. Ryzhakova G., Honcharenko T., Predun K., Petrukha N., Malykhina O., Khomenko O. Using of Fuzzy Logic for Risk Assessment of Construction Enterprise Management System. 2023 IEEE international conference on smart information systems and technologies (Astana, Kazakhstan, 4–6 May 2023). Astana : Astana IT University. P. 208–213. DOI: https://doi.org/10.1109/SIST58284.2023.10223560

11. Malikov V., Bila Y., Petrukha N., Andrieiev A., Bohatchyk L. Management of Accounting in Strategic Decision-Making for Enterprises. Journal of Information Systems Engineering and Management. 2025. Vol. 10. № 9s. P. 43–51. DOI: https://doi.org/10.52783/jisem.v10i9s.1135

12. Ryzhakova G., Pokolenko V., Malykhina O., Predun K., Petrukha N. Structural Regulation of Methodological Management Approaches and Applied Reengineering Tools for Enterprises-Developers in Construction. International Journal of Emerging Trends in Engineering Research. 2020. Vol. 8, № 10. P. 7560-7567. DOI: https://doi.org/10.30534/ijeter/2020/1428102020 URL: https://www.warse.org/IJETER/static/pdf/file/ijeter1428102020.pdf

13. Інклюзивний дизайн - це дизайн для всіх [Електронний ресурс]. URL: https://theukrainians.org/inclusive-design-eleks

14. DEDRICK, M. Foundations of user experience (UX) design. COURSERA lecture. 2020. URL: https://www.coursera.org/learn/foundations-user-experience design/lecture/9XHGZ/the-importance-of-equity-focused-design

15. Nielsen, J., & Sano, D. (1995). SunWeb: User Interface Design for Sun Microsystem's Internal Web. Computer Networks and ISDN Systems, 28(1&2), 179-188.

16. Bai, C.; Zang, X.; Xu, Y.; Sunkara, S.; Rastogi, A.; Chen, J. UIBert: Learning Generic Multimodal Representations for UI Understanding. arXiv 2021,

arXiv:2107.13731.

17. Banerjee, P.; Mahajan, S.; Arora, K.; Baral, C.; Riva, O. Lexi: Self-Supervised Learning of the UI Language. arXiv 2023, arXiv:2301.10165.

18. Inclusivity in Design Microsoft Toolkit Manual. [online]. 2016. URL: https://www.microsoft.com/design/inclusive/

19. Material Design. Top App Bar-Material Design 3. URL: https://m3.material.io/components/top-app-bar/guidelines.

20. Cooper, A.; Reimann, R.; Cronin, D.; Noessel, C. About Face: The Essentials of Interaction Design; John Wiley & Sons: Indianapolis, IN, USA, 2014.

Анотація. *Інклюзивний дизайн - один із найпотужніших та найуспішніших методів покращення користувацького досвіду для людей різного походження, ідентичності та досвіду. Стаття присвячена формуванню та побудові логічних ланцюгів в UX-дизайні для цифрової інклюзивності. Були розглянуті публікації, в яких пропонувалися шляхи вирішення завдань щодо доступності UX-дизайну для всіх користувачів.*

Інклюзивний дизайн - це «просунута тема» у сфері UX-дизайну, в якій багато прикладів інклюзії. У сучасному світі технологій потреба в адаптації цифрових продуктів до різних умов використання зростає, що вимагає врахування різних фізичних, сенсорних і когнітивних можливостей. В сфері дизайну початок нового десятиліття означає більший акцент на інклюзивному дизайні. Як наслідок, UX-фахівці в IT-секторі все частіше прагнуть розробляти справді інклюзивні продукти та враження. Цей підхід не лише усуває бар'єри, а й забезпечує комфортне користування для кожного, спрощуючи доступ до інформації та функцій, що є важливим аспектом соціальної рівності.

Інклюзивний дизайн націлений на створення доступних і зрозумілих продуктів для всіх категорій користувачів, включаючи людей з обмеженими можливостями. Це дослідження представляє допоміжний метод проектування для вирішення цієї проблеми. У ньому пропонується метод навчання послідовному представленню для кластеризації TAB у репозиторіях програмного забезпечення на основі їхньої структури. Початківець-дизайнер може ввести свою попередньо концептуалізовану структуру, щоб отримати приклади дизайну з кластерів TAB репозиторію програмного забезпечення, які мають структури, ідентичні або подібні до їхніх концепцій. Експериментальні результати демонструють ефективність методу, досягаючи точності 66,7% та балу F-1 0,717, що підкреслює його відповідність людській кластеризації. Цей метод не тільки підвищує ефективність проектування UX-дизайну для цифрової інклюзивності, але й допомагає зрозуміти успішні дизайнерські практики в різних контекстах.

Ключові слова: *UX-дизайн, доступність, інклюзивний дизайн, допоміжні технології, візуальний дизайн інтерфейсу користувача.*

Стаття надіслана: 08.07.2025 р.