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IDENTIFYING INTERFACE USABILITY FACTORS

This article addresses the relevant task of ensuring the usability of digital interfaces in the early stages of their design. The necessity of transitioning from an intuitive to a systematic approach in prototyping is substantiated due to the increasing complexity of software products and the risks of accumulating architectural errors. An approach to identifying the key interface quality factors based on a systematic literature review was proposed. Based on the defined research questions, a structured search query was developed, combining domain terms, quality metrics, and methodological filters. The sample formation and source analysis were conducted using the international PRISMA methodological protocol, which allowed for the selection of 19 relevant full-text scientific papers from the Scopus and Web of Science Core Collection databases. Four key groups of factors that have a significant impact on usability were identified and systematized: structural-logical, visual perception, context of use, and prototype fidelity. A classification of typical interaction problems was developed, among which navigational gaps caused by designing from an internal system hierarchy, visual-ergonomic screen overload, a lack of system feedback, and the cognitive-emotional exhaustion of users dominate. The practical significance of the obtained results lies in the possibility of using the formed knowledge base to develop specialized engineering checklists and algorithms for heuristic interface evaluation. The application of these results allows for improving design accuracy, optimizing testing costs, and minimizing the risks of redesigning the architecture at the coding stage.

Keywords: usability, user experience, interface design, prototyping, prototype fidelity, interface evaluation, systematic literature review, factor.

1. Introduction. Modern digital systems have reached such a level of functional complexity that human cognitive load becomes the main barrier to effective task performance. Today, user experience (UX) does not merely accompany a software product but determines its viability. Systems are expected to provide a logical, transparent, and barrier-free digital environment. However, the practice of intuitive design still dominates, where the interaction architecture is formed without deep preliminary analysis, and usability verification is postponed to the later stages of development. This leads to navigational gaps, emotional frustration, and product abandonment. Identifying the key influencing factors and understanding the mechanics of typical errors allow developers to transition to a scientifically grounded design model. This necessitates an in-depth analysis of the current scientific discourse regarding the approaches, methods, and criteria for evaluating the quality of digital prototypes.

2. Problem Statement. Despite a significant number of empirical studies in the UI/UX field, the current scientific basis regarding interface quality criteria remains fragmented and primarily focused on narrow subject areas. The lack of a unified classification of universal usability factors and typical user problems specifically at the conceptual prototyping stage complicates the creation of standardized evaluation metrics. This creates a need to consolidate scattered data into a cohesive methodological structure suitable for practical engineering application.

3. Analysis of Recent Research. To objectify fragmented empirical data, modern research in the field of user experience and interface design increasingly relies on the methodology of systematic literature reviews, specifically following the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) standard.

In [1], the PRISMA approach was applied to analyze the usability of voice user interfaces. The authors emphasize that a systematic review minimizes bias and ensures transparency in the process of selecting quality criteria. A similar methodological approach was used in [2] while analyzing the evolution of educational chatbots. Their study demonstrates how strict inclusion and exclusion criteria help identify gaps in graphical interface development methods and approaches to their testing. Study [3] is dedicated to the systematization of usability concepts in gamified systems. Through a systematic search in leading scientometric databases, the authors collected hundreds of scattered recommendations and grouped them into a single set of guidelines.

4. Main Results. To identify interface usability factors, a systematic literature review was conducted according to the methodology [4]. The following research questions (RQs) were formulated:

RQ1: What groups of factors have the most significant impact on interface usability at the prototyping stage?

RQ2: What are the main problems that arise when using interfaces?

The following inclusion criteria were defined: only peer-reviewed scientific papers published in journals indexed in the Scopus or Web of Science Core Collection databases are included in the analysis; the primary focus is on interface usability issues; the selected works must outline factors, parameters, or requirements related to interface usability. The exclusion criteria were as follows: studies not written in English are excluded; publications without full open access that cannot be comprehensively analyzed are also excluded.

Considering the research questions, the following search string was formulated:

$$(userinterface* \lor prototype* \ OR \ \ interface\ design *)$$

$$\land (\ usability \ \lor \ user\ experience \ \lor \ ease\ of\ use\ )$$

$$\wedge \left(\begin{array}{c} fideliti \ \vee \ usabilitytesting \ \vee \\ usability\ evaluation \ \vee \ user\ testing \end{array} \right).$$

The use of the asterisk (*) wildcard ensures the inclusion of all grammatical variations.

The PRISMA flow diagram [5], developed to demonstrate the logic of searching for relevant scientific studies, is presented in Figure 1.

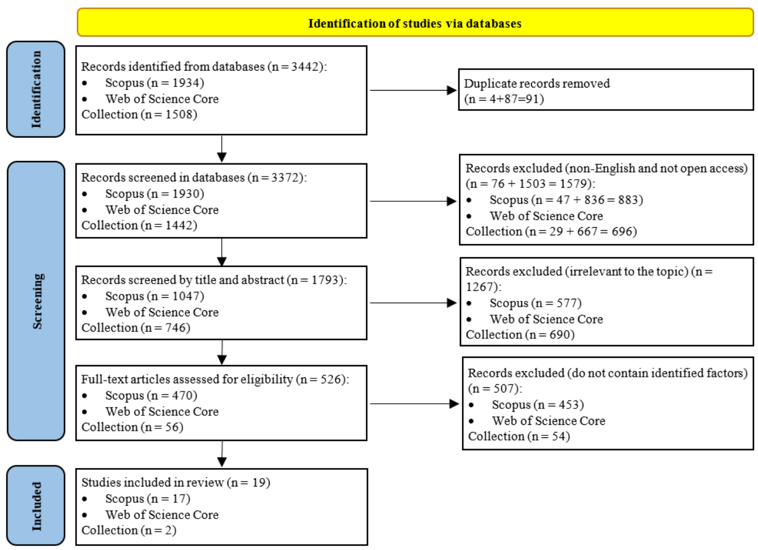

Figure 1. PRISMA flow diagram.

The sample formation process was carried out in accordance with the PRISMA protocol. At the identification stage, 3442 publications matching the search query were found in the Scopus and Web of Science scientometric databases. As a result, 19 scientific papers published between 2016 and 2025 were included. The sample covers empirical studies, theoretical reviews, project-oriented works, etc., directly related to prototyping, interface quality evaluation methods, and user experience factors.

The analysis of the selected array of scientific publications allowed for the identification of key groups of factors that have a significant impact on interface usability during their design. To transition from an intuitive design to an engineering-based approach, it is necessary to consider four main clusters: structural-logical factors, visual perception factors, context of use factors, and prototype fidelity factors. Within each group, specific determinants that directly affect the quality of interaction were identified.

Structural-logical factors form the fundamental level of interaction and determine the extent to which the system's architecture aligns with the user's mental model. This group includes the following factors: continuity of the task flow [6], architectural transparency and hierarchy depth [7, 8], and cognitive load optimization. Visual perception factors relate to the mechanisms of perceiving information from the screen and managing user attention. These include: spatial arrangement and visual weight [9], the visibility of interactive elements [10], and color semantics and contrast [11]. Context of use factors indicate that usability is a relative value that depends on the target audience and the product's application environment. The key factors here are: correspondence to the user persona [12–15], the specifics of the interaction environment [16], and trust and security [17, 18]. Prototype fidelity factors determine the methodological accuracy of the testing process and the validity of the obtained results. Choosing the right balance between these factors determines the economic feasibility of error detection. The factors in this group are: the level of graphical abstraction [19, 20] and the level of functional interactivity [21].

The answer to the second research question is based on the analysis of problems identified in empirical studies.

An in-depth analysis of the identified problems indicates that navigational gaps remain the most common systemic defect. In corporate portals [7] or e-government applications [13], developers often duplicate the bureaucratic hierarchy directly in the design. This leads to the user being forced to learn the administrative structure instead of performing their direct task. Eliminating this problem requires the application of an object-oriented approach to navigation design. Visual perception problems today are the result of a conflict between rich functionality and minimalist trends. Eye-tracking research [9] shows that interfaces with a dense data layout cause chaotic eye wandering. On the other hand, excessively hiding elements in mobile applications [10] for the sake of design "cleanliness" radically reduces the visibility of important functions. A significant volume of critical problems is related to feedback. The lack of an immediate system micro-reaction (e.g., click animation) and macro-reaction (a clear data processing status) leads to a state of uncertainty. Studies [18, 22] confirm that a deficit of system transparency and unclear error messages are the main triggers for abandoning applications in the service and finance sectors. Finally, cognitive-emotional problems, which are recorded using hierarchical heuristic analysis [23] and emotion recognition systems [24], arise due to the overload of human working memory. When an interface uses professional terminology instead of familiar vocabulary [16] or does not easily allow the undoing of an erroneous action, the user experiences frustration. This destroys a positive user experience even if the software code is technically flawless.

5. Conclusions and prospects for further research. The conducted study allowed for the systematization of modern approaches to ensuring the usability of digital interfaces. It was established that the quality of interaction is determined by four key groups of factors: structural-logical, visual perception, context of use, and prototype fidelity. Ignoring these factors at the early stages of development leads to the accumulation of errors, which are later difficult and expensive to correct.

As the analysis showed, the main obstacles in interface usage are predominantly of a design rather than a technical nature. Users most often encounter illogical navigation, visual screen overload, a lack of clear system feedback, and cognitive exhaustion. Most of these barriers arise precisely when an interface is built around the internal logic of the system or organization, rather than around the actual goals of the user.

Conflicts of interest

The authors declare that they have no conflicts of interest in relation to the current study, including financial, personal, authorship, or any other, that could affect the study, as well as the results reported in this paper.

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Data availability

All data are available, either in numerical or graphical form, in the main text of the manuscript.

Use of artificial intelligence

The authors confirm that they did not use artificial intelligence technologies when creating the current work.

Author contributions

A. V. Kudryashova – conceptualization, data preparation, formal analysis, scientific supervision, methodology, project administration, writing (reviewing and editing); Yu. O. Biletsky – research, resources, visualization, writing – original project, translation design, text type validation; M. M. Klyap – data curation, methodology testing, external communications, financial support, experimental design development; N. Ya. Shumylo – software, mathematical modeling, results verification, critical analysis of system architecture.

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Кудряшова А. В., Білецький Ю. О., Кляп М. М., Шумило Н. Я.
Визначення факторів зручності користування інтерфейсами.

У статті розглянуто актуальну задачу забезпечення зручності користування цифровими інтерфейсами на ранніх стадіях їх проєктування. Обґрунтовано необхідність переходу від інтуїтивного до системного підходу в прототипуванні через ускладнення програмних продуктів та ризики накопичення архітектурних помилок. Запропоновано підхід до виявлення ключових факторів якості інтерфейсів на основі систематизованого літературного огляду. На основі визначених дослідницьких питань розроблено структурований пошуковий запит, що поєднує терміни об'єктної області, метрики якості та методологічні фільтри. Формування вибірки та аналіз джерел виконано з використанням міжнародного методологічного протоколу PRISMA, що дозволило відібрати 19 релевантних повнотекстових наукових праць з баз Scopus та Web of Science Core Collection. Виокремлено та систематизовано чотири ключові групи факторів, що здійснюють суттєвий вплив на зручність користування: структурно-логічні, візуального сприйняття, контексту використання та рівня деталізації прототипу. Розроблено класифікацію типових проблем взаємодії, серед яких домінують навігаційні розриви, зумовлені проєктуванням від внутрішньосистемної ієрархії, візуально-ергономічне перевантаження екранів, дефіцит системного зворотного зв'язку та когнітивно-емоційне виснаження користувачів. Практичне значення отриманих результатів полягає у можливості використання сформованої бази для розроблення спеціалізованих інженерних чек-листів та алгоритмів евристичного оцінювання інтерфейсів. Застосування результатів дозволяє підвищити точність проєктування, оптимізувати витрати на тестування та мінімізувати ризики перероблення архітектури на стадії написання програмного коду.

Ключові слова: зручність користування, користувацький досвід, проєктування інтерфейсів, прототипування, рівень деталізації прототипу, оцінювання інтерфейсів, систематизований літературний огляд, фактор.

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