AI-DRIVEN INNOVATION IN WEB APPLICATION USER EXPERIENCE

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Abstract

The rapid development of Artificial Intelligence (AI) technologies has changed the design and functionality of user interfaces, making AI capabilities an integral part of modern web applications. This research focuses on the necessary features and best practices for designing user interfaces that effectively incorporate AI functionalities while maintaining user-friendliness and control.

This paper explores the key principles of user interface (UI) design and the challenges faced when integrating AI into web applications. It highlights the importance of achieving a balance between leveraging AI's advanced capabilities and ensuring that users can intuitively understand and interact with the system. By emphasizing intuitive and engaging UI designs, the study aims to empower users to seamlessly utilize AI-driven features.

The research provides a deep analysis of design techniques that are specifically tailored for AI-enabled web applications, including AI-driven recommendation systems, personalized interfaces, and adaptive designs that adjust dynamically to user preferences and behaviors. In order to validate the proposed principles, the study outlines a framework for guidelines that encourage empirical evaluations through user studies and usability testing.

The results of the survey are presented to evaluate the effectiveness and user satisfaction of AI-enhanced web interfaces in real-world scenarios. The findings bring to light how UI design decisions impact user interactions and overall experience. This study offers practical guidelines for designers and developers, which can contribute to a better understanding of designing user interfaces for AI-supported web applications. By applying these principles, organizations and developers can create web interfaces that maximize AI's potential while prioritizing user-centricity, accessibility, and ethical standards.

INTRODUCTION

1. The rapid growth of Artificial Intelligence has revolutionized many different domains, including web applications by improving the user experience and enabling personal and intelligent interaction. The AI-enabled web applications have great potential in enhancing human-computer interaction, but designing the UI of such systems is a task that presents some unique challenges. This is because it poses the need to balance between advanced functionalities of AI with intuitive user interaction.
2. From developing new robotics, natural language, or virtual or augmented realities in their applications, interaction methods are changing. IxD guides through its five-dimensional spaces: words (1D), visual representations (2D), physical objects or space (3D), time (4D), and behavior (5D), navigating the complexity of human life. To design and build interfaces that effectively utilize AI capabilities to meet needs is crucial for understanding those five dimensions.
3. This paper presents a guideline for the design of UIs with AI-enabled web applications. This is aimed at helping designers create intuitive, efficient, and trustworthy interfaces that take full advantage of the capabilities of AI while remaining user-centric. The three key objectives are: building user trust, providing clarity, and empowering users to interact seamlessly with AI-driven features.
4. The major challenge of AI-driven systems is their opaqueness. Most AI algorithms operate behind the scenes, where decisions are made

without any clear evidence to the user. This may lead to confusion or mistrust. The guidelines proposed above stress transparency, user control, and ethical considerations in the design process.

5. The study is grounded in a literature review that identifies 16 fundamental principles for UI design, such as affordance, discoverability, feedback, consistency, personalization, and error prevention. A subset of these principles was used to develop a prototype, followed by user surveys to evaluate its effectiveness. The iterative design process—involving testing, feedback, and refinement—ensures adaptability to evolving AI technologies and user expectations.
6. In addition to these considerations, the paper underlines the importance of ethical AI integration in UI design. Designers need to address issues of data privacy, algorithmic bias, and transparency in order to gain the trust and confidence of users. Ethical considerations not only increase user satisfaction but also fit into broader regulatory and societal expectations.
7. This research also explores how adaptive designs can be leveraged to develop AI-based UIs that are accessible and user-friendly for a large user population. Adaptive designs utilize AI to dynamically alter interface elements based on users' preferences, behaviors, and accessibility needs. Such designs make interfaces more inclusive and responsive, accommodating users with diverse levels of technical expertise and physical abilities.
8. Moreover, the paper shows how gamification and micro-interactions can be applied to make AI-enabled UIs more interesting. Designers can integrate game-like elements and subtle feedback mechanisms in order to create interfaces that are both functional and enjoyable. Such techniques reduce user frustration and make users more likely to engage with AI features in depth.
9. This paper is organized as follows: Section 2 discusses the foundational UI principles applied in prototype development. Section 3 describes the subset of guidelines used for implementation. Section 4 presents survey results and their analysis, while Section 5 concludes with key findings and recommendations for future work.

Design principles and guidelines applied to prototype

Based on [7], a work of the authors, was identified and compiled a subset of design guidelines for the interfaces of AI systems. Based on the current state of the art in the field, the closest guidelines were selected to be demonstrated in an interactive prototype of this artifact. The prototype has been developed and tested concerning usability factors. The objective of the testing was to see whether the proposed principles could allow users to achieve their desired tasks in a pleasant, efficient, and safe manner. The guidelines that are presented and tested in a prototype detailed in section 3, are resumed as follows:

• Affordance: is the quality or property of an object that defines its possible uses or clarifies how it can or should be used. For instance, while viewing a chair, it would seem rather obvious that the purpose is for us to sit on it [12]. It is a resource available in an animal's environment that the animal needs to have the skills to sense and utilize; the object, in this example is the AI system, the animal is the human being, [13].

•\tDiscoverability: the ease with which users can discover all the elements and features of a system when they first experience it. An AI system should be learned quickly and effortlessly by new users. Example: Discoverability depends on many factors. Applying the main guidelines when designing an interface is likely to achieve the desired effect.

•\tFeedback: proper communication must be done in both directions. Thus, feedback at all points of interaction is essential for usability.

•\tInternal & External Consistency: internal consistency (within the system itself) and external consistency (in accordance with the expectations and standards of the industry it belongs to) are very important in AI systems.

• \tEase of forgetting: the complexity and dynamism with which we live our lives are such that patterns may not remain consistent over years, or even months. It is crucial to force the most used applications to forget the learning process and start learning again, aiming for better or simple more current results. In the case of advanced AI systems, a quick reset/stop may be considered, allowing the system to be restarted with factory settings, as well as running temporarily in safe mode (no AI).

• \tHelp and Documentation: however well designed the systems are, they should always have useful, simple, and efficient documentation. If, on the one hand, we have the tasks of customization and advanced user customization, on the other hand, interoperability will be important in this type of system, as well as the possibility of integrating more functions, so documentation for the "programmers" should also be a reality to consider.

Conclusion The defined design principles present a well-founded foundation for establishing an AI system interface artifact. Examples of the principles defined will be used in the following topic since we'll explore the particular details of the prototype to follow.

3. Prototype Development

Hevner et al. [19], March et al. [20], and Nunamaker et al. [21] further explain what IT artifacts are, which are important results of IS research. In this study, we linked the Design Science Research Process framework [22] with the themes of our study to generate an artifact. The aim was to demonstrate the relevance of a set of specific guidelines, which were embedded into a prototype designed for this exact purpose. The chosen principles were derived from two major objectives:

1.

To show the most consistent principles within the state of the art established in [7]:

o Affordance

o Discoverability

o Reliability & Predictability

o Feedback

o Internal & External Consistency

2. \tTo determine if a current guideline for AI systems can be implemented and serves as an added measure toward improving the perceived reliability and safety of the system:

ease of forgetting

These objectives were both achieved through the "Vitamina AI" prototype development as illustrated in Figure 1. Both of these were shown to the audience throughout the user flow of a proposed AI system that would suggest, order, and deliver the appropriate dietary supplements and vitamins depending on the biometric data, objectives, and lifestyle of users.

Functionalities of the Vitamina AI Prototype

The functionalities of the "Vitamina AI" prototype are directly aligned with the key guidelines we aim to highlight. Below is an example of how each guideline was implemented in the prototype:

• \tAffordance Example: Users can intuitively interact with sliders, buttons, checkboxes, and other elements designed with clear affordances, such as an X-shaped icon to close messages or a toggle to enable specific features.

• \tDiscoverability Examples:

1. \tIn the "Hero" section, well-structured information, prominent CTA buttons, and a clear layout make it easy to navigate and discover features.

2. \tIn the footer, users can find help menus and contact options, which makes navigation smooth.

• \tReliability & Predictability Examples:

1. \tClear and timely information reduces user anxiety by communicating what is happening.

2. \tNatural language usage throughout interactions to build trust and understanding.

3. Transparency of the system's limitations, for example, how accurate it is or what functionalities it offers.

• Feedback Examples:

1. Interactions give users full and actionable feedback, guiding them quickly to the desired results.

2. Critical actions involve confirmation prompts with options to reverse decisions, making it more user-friendly and less prone to errors.

• Internal & External Consistency Examples:

1. Internal consistency is achieved by using the same fonts, colors, and design elements throughout the site.

Question	Results		
	Yes	No	Yes, with difficulty
After performing task 1, did you understand the objectives of the platform?	97,6 %	0%	2,4%
Were you able to complete task 2?	95,1 %	0%	4,9%
Were you able to complete task 3?	95,1 %	0%	4,9%
Were you able to complete task 4?	97,6 %	0%	2,4%
Were you able to complete task 5?	97,6 %	0%	2,4%

2. External consistency can be achieved using recognizable industry elements, such as pillbox icons and human avatars that provide an empathetic interface.

• Example of Ease of Forgetting: Users may reset the entire system back to factory setting or can easily initiate the safe mode which temporarily deactivates the AI and gives users a sense of control over the system for safety.

•\tHelp and Documentation Example: A help page should include a search bar for specific queries, task-oriented menus, and a clean layout to make support easily accessible and intuitive.

Conclusion of Prototype Development

The development of the Vitamina AI prototype successfully demonstrates the applicability of the chosen guidelines in creating an AI-powered interface. By aligning functionalities with key principles, the prototype ensures a user-friendly, efficient, and trustworthy interaction experience. The next section will delve deeper into the user testing and evaluation processes conducted to measure the prototype's effectiveness in real-world scenarios.

4. Results Discussion

I In this study, a method referred to as "Empirical Evaluation with Questionnaire" was used, which is based on the structured data collection method as described by [17]. The questionnaire combined closed-ended questions for quantitative analysis and open-ended questions for qualitative feedback, and both ordinary users and design professionals were involved. This ensured that the questionnaire provided a holistic understanding of user interactions with the prototype and therefore a strong evaluation of its performance. The questionnaire was structured into three main parts:

•\tDemographic Data: General demographic background and background information of participants.

•\tPlatform Usage: Completing five tasks which were mainly distributed across all aspects of navigation and operation.

•\tUser Experience: General assessment on user experience.

The study involved 41 participants, aged between 18 and 51, with 53.7% of them being regular users and 46.3% being interface design and user experience professionals. Participants had various levels of education, and 61% of the participants held a college degree. Participants included Portuguese living in Portugal and abroad as well as foreign citizens speaking Portuguese.

During the assessment, participants were asked to perform a set of activities that would test the prototype's functionality and usability. These activities were designed such that they would mimic natural interactions with the platform. For each task, we outline below:

•\tTask 1: Navigating the homepage.

•\tTask 2: Create a biometric profile.

•\tTask 3: Access the personal area.

•\tTask 4: Erase your data/biometric profile.

•\tTask 5: Go back to the homepage from the Personal Area.

The results indicate agreement with the goals of the research; over 95% of users completed all tasks without any difficulties. The detailed results concerning the tasks performed are found in Table 1.

A video tutorial was also applied to the questionnaire. The tutorial demonstrated how to navigate the platform and complete tasks. However, the majority of users, 90.2%, said they did not require any visual aids to operate the application. That testifies to the intuitiveness and user-friendliness of the prototype. Participants were also asked to choose the attributes that, according to them, best described their experience with the platform. The answers suggest that the Large scale goals of the guidelines were met.

1. Safety: 73.2% of participants felt safe while interacting.

That proves that including

reliability and predictability from the design principles is working well for the prototype regarding this important aspect.

2. Intuitiveness: 70.7% answers were in line with "ease of discovery" and "ease of use."

Users found their way and acted appropriately according to the proposed activity.

3. Simplicity: 70.7% of the users believed the system was "simple". This indicates that

"internal and external consistency" is noticed. The simplicity of the interface, in tandem with industry standards

and the expectations of the users themselves, adds much value to this dimension.

4. Pleasantry: 63.4% of the users could see that the platform had made efforts to deliver an interaction environment

which would be "pleasant and delightful".

5. Functionality: 58.5% of the users acknowledged "functionality" as a characteristic of the platform. This

its proximity to the concept of "affordance".

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6. Reliability: 48.8% acknowledged that "reliability" represents the principles of "feedback" and "reliability and

predictability" have yielded results. With scope for improvement in this aspect.

The views of the users confirm the aptness of the guidelines provided and implemented into the prototype, which agrees

their relevance and positive impact on the user experience. In addition, it was used The Net Promoter Score, an indicator of loyalty and satisfaction [18].

Based on these quantitative results, we will analyze the qualitative open answers in the next section. These can help us understand these positive results, as well as the less positive ones.

ANALYSIS OF USER FEEDBACK

The specific comments received from the users invited to test the prototype were characterized by a variety of
impressions and suggestions that made it possible to understand the various aspects of its functionality, design and
usability.
The uniqueness of the idea was highlighted. These impressions highlight the prototype's
ability to capture users' attention and to elicit positive reactions.
Participants found the prototype capable of working with AI in the medical sphere, with using such systems in the
AI field. Pointing out particularly, the application of the received recommendations relevant to health problem people
This means the prototype potential to be useful in such a sphere, even very critical, like the sector of its development.
as sensitive as health. Some users discussed the user-friendliness and ergonomics of the system. Some users mentioned that this
solution was functional, intuitive, but others have argued that some people who don't come from a technological background, or
even who lack technical knowledge would still have discomfort or face

some barriers.

A repetitive comment described that there should be the provision to access the menu during the different submodules navigation.

the prototype, which suggests improving "System visibility" can help better apply the whole experience. Regarding aesthetic and conceptual analogies, one comments compares the design of this prototype to a movie description of some kind of future scenario. Again, this analogy is the kind of analogy that people have with a population eating synthetic foods to stay alive. This analogy reflects just the kind of futuristic theme of the prototype, although

It also highlights the need for balancing aesthetics with the functional aspects of the technology, especially in the context of a health-focused application.

Fig-2: Arduino Cable

CONCLUSION

The variety of comments received offers relevant information about the prototype's strengths as well as areas deserving attention. The views expressed denote the aesthetic effect, usability, and potential applications of the prototype. At the same time, they point to concrete areas of improvement. The constructive nature of the feedback reveals the usability testing potential to make user-centered

improvements. And how these might further optimize the functionality, usability, and design of the prototype, thus contribute to its efficiency as an AI-assisted healthcare technology solution.

According to the answers to the questionnaire, it was understood that following the implemented guidelines is not only effective but

also valued by users, especially by the third, fourth, and even more so by the guidelines of the developed structure, such as 2, 3, and 4. These

This can be understood from comments by users though they do not have to be cognizant of the guidelines'

direct applicability

General comments do confirm findings of the User Experience (UX) parts of the questionnaire

There is high interest and eagerness of the users to engage with such a platform which translates to readiness

to recommend and also be willing to use the system in future. Such an acceptance will depend on the platform

Meeting the user expectations and UI/UX, which have to reflect users' best interests,

Feedback on these guidelines clearly emphasizes guideline number 3 and how critical reliability should be for such an

interfaces. The reliability has to come about from persistent optimization given UX Research. Users do, to some

extent, protect themselves within these systems and were accounted for as part of the structure for this process.

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The user feedback also drew attention to the importance of both internal and external consistency in interface design,

especially with the innovative system of the prototype. Improvements to the interface will be made to better address the issues of consistency, as outlined in guideline 4, and hopefully produce better results in general.

All users have different experiences and different backgrounds. In this sense, it can be difficult to obtain a result

that pleases everyone.

Ensuring a safe, intuitive,

A simple, pleasant, and efficient experience will be integrated into the interface design process of the new

independent and intelligent systems that are to come.

As future work, it is intended to develop a website based on the implementation of all the guidelines identified to

heuristically cover all the aspects of a website.

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