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User Interaction Interface Design and Innovation Based on Artificial Intelligence Technology

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Abstract: ***At a time when artificial intelligence is widely used in all walks of life, the way users interact with the digital world also needs to incorporate intelligent elements to reduce the cost of connectivity. This cost can be quantified through "experience metrics", which reveal the problems users encounter when using the interface (UI), and make targeted optimization. With AI, deep learning and prediction of user behavior can be achieved to anticipate and address potential barriers to use in UI design. This will not only improve the user experience, but also promote the development of UI design in a more user-friendly and intelligent direction. Through accurate analysis of experience indicators and combined with AI technology to optimize design, the gap between users and the digital world can be greatly reduced, making digital products more suitable for user needs and achieving seamless interactive experience.***

Keywords: User interaction; UI design; Artificial intelligence; User interface innovation.

1. INTRODUCTION

Since the birth of computers, the first generation of user interface paradigms, produced around 1945, was batch processing. In this paradigm, users specify a complete workflow of all the actions they want the computer to perform. In the digital age, artificial intelligence (AI) is rapidly changing the way we interact with businesses, especially in improving customer experience and providing convenience. AI analyzes customers' historical data and behavior to deliver personalized experiences. Whether it's product advice in e-commerce or investment advice in finance, AI is able to tailor the advice to the needs and preferences of the customer, making the customer feel more valued. Based on user input and feedback, artificial intelligence can intelligently push content that may be of interest to users and simplify user operation process [1]. In addition, AI can also provide users with personalized recommendations and suggestions by learning users' usage habits and preferences, making the user's use experience more personalized and comfortable.

AI's prediction of each user's usage habits, user preferences, and consumption behavior benefits from the massive data and machine learning capabilities of AI applications [2] [3]. Training AI language models today can provide new dimensions and Spaces for different domains, as well as highly personalized services and experiences for users. In everyday interactions between application providers and consumers, the provider is mediated by the GUI, and the core achieves two goals: hosting information and providing interaction. To carry information relative to the user perspective is to obtain information, to provide interaction for the user perspective is to interact, so it can be seen that interaction is a communication interaction between the user and the provider through the GUI. Von Neumann abstracts the computer architecture into: arithmetic, controller, memory, input device, output device, based on this unified abstraction, he treats the program as data, and puts it together with the data in the memory, so that the computer can call the program in the memory to complete the computer control. This design idea directly led to the separation of hardware and software, so that hardware and software design can be executed separately, thus giving birth to the programmer profession. [4]System programmers are responsible for writing program instructions to read, translate, and analyze from memory, and then send control commands to the computer and input and output according to the instructions, in fact, they are writing operating systems, kernel modules, device drivers, and so on. Application programmers are on the basis of the former, develop a variety of applications, such as Linux file to abstract I/O to provide file handle for operation, application programmers can use these file handles to develop a file compression decompression application.

2. RELATED WORK

2.1 User and digital interface challenges

The current user interaction with digital interfaces is often faced with a number of challenges, one of the main problems is the inconsistent user experience [5-7]. With the rapid development of digital technology, users expect a more fluid and intuitive interactive experience. However, many interface designs remain complex and difficult to use, making it difficult for users to quickly find the information they need or complete specific tasks. This not only increases the user's operation difficulty, but also reduces the overall satisfaction and efficiency. In addition, the lack of personalized experience is also a key problem, many interface designs do not fully consider the individual differences and preferences of users, resulting in the recommendation of services and content can not accurately meet the needs of different users.

Another common problem is lack of accessibility and inclusion. While the proliferation of digital technologies is intended to provide convenience to a wide range of users, some UI designs fail to adequately take into account the needs of people with disabilities or technologically unskilled users, leaving this segment of the population with additional barriers to use [8]. For example, for users with poor vision, if the interface design lacks sufficient contrast or does not support screen readers, it will greatly affect their experience. In this case, the lack of in-depth understanding of diverse user needs and adaptive design not only limits the accessibility of the product, but also ignores an important user group, reducing the universal applicability and impact of the product.

2.2 Experience the importance of metrics

Experience metrics are key data points that measure the quality of a user's interaction with a digital interface, and they can quantitatively reflect various aspects of the user experience, such as usage efficiency, satisfaction, ease of use, and user engagement [9]. By collecting and analyzing these metrics, designers and developers can identify problems and deficiencies in the UI, such as which features confuse users, which action paths lead to inefficiencies, or which interface elements fail to interest users. Experience metrics make the UI optimization process more data-driven, rather than relying solely on subjective judgments, thus improving the accuracy and effectiveness of decisions.

For example, on an e-commerce site, experience metrics might include page load time, cart abandonment rate, click-through rate, average time spent on the page by users, and so on. For example, if the analysis finds an unusually high shopping cart abandonment rate, it could indicate a problem with the checkout process, such as the process being too complex or the page taking too long to load. From this, development teams can make targeted improvements, such as streamlining the purchase process or optimizing page performance, to increase user satisfaction and conversion rates [10-12].

Here's an example of a user heatmap on a fictional e-commerce website. This visualization demonstrates areas of high interaction in red, indicating where users click the most, and areas of low interaction in blue, indicating less engagement.

Figure 1: Example of a user heatmap on a fictional e-commerce website

Therefore, in practice, the analysis of experience metrics is often done through a variety of tools and platforms, such as Google Analytics, Hotjar, etc., which can help teams collect user behavior data, create heat maps, and record user sessions to visually show how users interact with the interface [13-15]. For example, a heat map can show the areas a user clicks most frequently, while a user session recording can reveal the obstacles a user encounters in a particular task. With these specific data and visual tools, the team was able to gain a deeper understanding of user behavior and identify specific aspects of UI design that needed to be optimized.

2.3 The combination of AI and UI design

For AI, having better availability should be an important competitive advantage. (If you're considering becoming a prompt engineer, don't expect it to be a career that lasts.) The current chat-based interaction is also problematic because it requires users to write questions in plain text [16]. Based on recent literacy studies, I believe that even in rich countries, about half of the population is not articulate enough to get good results from chat interactions with current AI bots. In a command-based interaction, the user issues the computer one command at a time, gradually producing the desired result (provided the design is usable enough to understand what commands need to be issued at each step). The computer is completely compliant and follows instructions to the letter. The downside of this paradigm is that low availability often results in users issuing commands that do not have the effect they expect.

In the new AI system, instead of telling the computer what to do, the user tells the computer the outcome they want. Therefore, the third generation of user interface paradigms represented by current generative AI is Intent-based outcome specification.

2.3.1 Compared to GUI, CUI interface

For AI, having better availability should be an important competitive advantage. (If you're considering becoming a prompt engineer, don't expect it to be a career that lasts.)[18] The current chat-based interaction is also problematic because it requires users to write questions in plain text. Based on recent literacy studies, I believe that even in rich countries, about half of the population is not articulate enough to get good results from chat interactions with current AI bots. In a command-based interaction, the user issues the computer one command at a time, gradually producing the desired result (provided the design is usable enough to understand what commands need to be issued at each step) [19]. The computer is completely compliant and follows instructions to the letter. The downside of this paradigm is that low availability often results in users issuing commands that do not have the effect they expect.

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Compared to traditional interactive interfaces, CUI enables users to interact with systems through natural language dialogue, which opens new possibilities for digital product design. CUI's development will influence the way digital product design interacts, information architecture, process design, and more [20-22].

2.3.2 Interactive interface product service flow

Compared to GUI, CUI has several advantages in service process design:

(1) Natural Language Interaction (CUI) simplifies service process design and enables users to interact with systems in a natural, intuitive way. Users can express demands, questions or instructions through voice or text input, and the system can intelligently understand and process user input, and provide efficient and convenient services.

(2) Dynamic conversation flow: CUI system dynamically generates conversation flow based on user input and system logic to achieve intelligent and personalized service. The designer configures and optimizes the dialogue flow to suit the needs of different users and scenarios.

(3) Intelligent feedback and recommendations [23]: The AI-based CUI system provides intelligent feedback and recommendations by analyzing user input and behavior. For example, the system can automatically recommend

relevant services or information according to user needs, providing personalized and accurate services. This reduces user hesitation and improves the user experience.

(4) Data-driven optimization: The AI-based CUI system enables data-driven optimization and improvement by collecting and analyzing user input and feedback data. The system can automatically learn user preferences, behaviors and needs, optimize the dialogue model and dialogue logic, and continuously improve system performance and user satisfaction, improve service quality and efficiency.

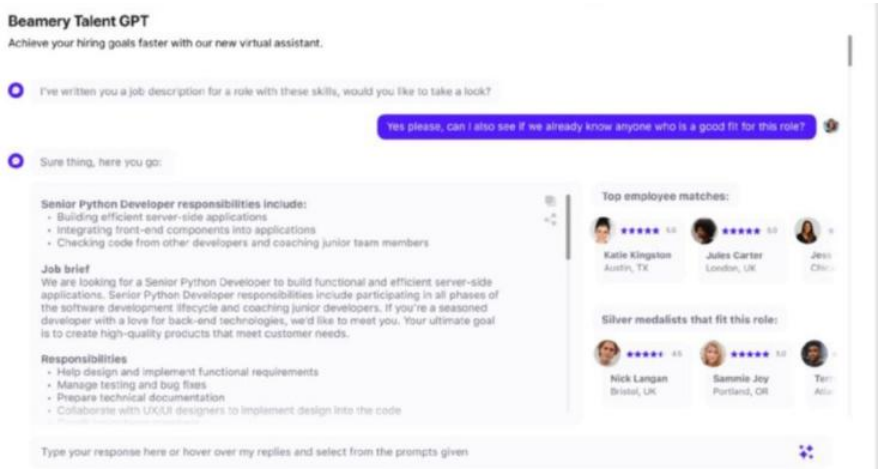

Figure 2: Beamery TalentGPT interface

In March 2023, Beamery, one of the pioneers of AI recruitment platforms, officially launched TalentGPT, the world's first HR generative AI. Beamery TalentGPT is an AI recruitment tool with capabilities such as talent search and matching, automated recruitment processes, intelligent candidate recommendation, talent insight and analysis, and job advertising optimization [24]. It uses natural language processing and artificial intelligence technology to help companies efficiently recruit and manage talent.

TalentGPT, for example, can automate candidate screening. Employers can set specific hiring requirements and qualifications, such as work experience, skills and education, and then have Beamery TalentGPT automatically screen out qualified candidates. This eliminates the need for employers to manually sift through a large number of resumes, greatly reducing the time and labor costs involved in the screening process.

TalentGPT also enables talent insights and analytics. Through the analysis and mining of recruitment data, he can generate talent insights and insight reports, including recruitment channel effectiveness, candidate sources, candidate turnover rate and other information, to help employers optimize recruitment strategies and decisions. In this way, employers can make more informed decisions based on the results of data analysis, thereby streamlining the recruitment service process and improving recruitment efficiency [25-28].

As you can see from this example, CUI's natural language interaction, dynamic conversation flow, intelligent feedback and recommendation, data-driven optimization, and cross-platform and multi-channel support in service process design are expected to play an important role in the future of digital product design.

3. APPLICATION CASES OF ARTIFICIAL INTELLIGENCE IN UI DESIGN

3.1 Implementation of personalized experience

The realization of personalized experience uses artificial intelligence to analyze user behavior and preferences to customize personalized UI interfaces. For example, recommendation systems on platforms like Netflix and Amazon use a user's viewing history, purchase history, ratings, and other behavioral data to provide personalized recommendations to users.

In Netflix, an AI system can learn about a user's likes and preferences by analyzing data such as the types of movies or TV series they watch, how long they watch them [29], how often they watch them, and what they like or dislike. Based on these data, the system can recommend similar types of film and television works to users, and

improve users' interest in and satisfaction with the recommended content. At the same time, Netflix will continue to update the recommended content according to the user's viewing habits, to ensure that users get the most personal taste of the viewing experience.

On Amazon, the recommendation system analyzes a user's purchase history, browsing history, search terms, and other interaction data. Through this data, the system can understand the user's purchase preferences, product preferences and interests [30]. Based on this information, Amazon will recommend products related to the user's interests, improve the likelihood of purchase and personalize the shopping experience.

The operation mechanism of these personalized recommendation systems mainly relies on artificial intelligence algorithms, such as collaborative filtering, content filtering, deep learning, and so on. These algorithms can automatically recognize and learn the user's interest pattern, and dynamically adjust the recommendation strategy according to the user's behavior, so as to realize the personalized recommendation service. In this way, users can find content that meets their interests and needs more quickly, improving the stickiness and loyalty of users to the platform.

Here's a schematic that shows how personalized recommendation systems on platforms like Amazon can provide personalized recommendations based on user behavior and preferences:

Figure 3: Amazon personalized recommendations

3.2 AI applications in augmented reality and virtual reality

In the field of augmented reality (AR) and virtual reality (VR), the application of artificial intelligence has brought users a more immersive experience. By combining AI technology, AR and VR can more accurately perceive the user's environment and behavior, resulting in a more authentic and personalized interactive experience. For example, intelligent recognition technology can help AR applications recognize and understand the user's environment, and then seamlessly integrate virtual content with the real world to provide users with a more realistic virtual experience. In addition, AI can adjust virtual content in real time based on user behavior and preferences, creating a more personalized interactive experience that enhances user immersion and engagement. For example: [30]Magic Leap is a company focused on AR technology, and they have developed an AR headset called Magic Leap One. The headset uses artificial intelligence technology to sense the environment around the user in real time and dynamically adjust the display position and appearance of virtual content according to environmental changes, thus achieving a more realistic and immersive AR experience. In addition, Magic Leap also analyzes user behavior and feedback through deep learning algorithms to provide users with customized virtual experiences, further improving the quality and personalization of the user experience.

3.3 Automated design processes driven by AI

The application of artificial intelligence makes the UI design process more automated and efficient. AI technology can help designers automatically generate UI elements and layouts, thus speeding up the speed and efficiency of design development. For example, deep learning algorithms such as Generative Adversarial networks (Gans) can automatically generate UI elements in a variety of styles and styles based on the designer's needs and inputs, reducing the designer's manual drawing effort while increasing the diversity and creativity of the design. In addition, AI can also optimize UI design by analyzing user behavior and feedback data, so as to achieve design effects that are more in line with user needs and expectations [31-33]. Adobe's Sensei project uses artificial intelligence technology to provide designers with a range of automated design tools. Among them, Auto Reframe is a tool that uses machine learning algorithms to automatically adjust the size and layout of videos, which can

automatically optimize the video layout according to different platforms and equipment requirements, saving designers a lot of time and energy [34]. In addition, the Design Intelligence function in Adobe XD uses AI to analyze user behavior and preferences during the design process, providing designers with real-time feedback and suggestions to help them complete design tasks more quickly, improving the efficiency and quality of design.

Through the above examples, it can be seen that the application of artificial intelligence in augmented reality and virtual reality, as well as UI design automation, brings users a more immersive and personalized experience, but also improves the efficiency and creativity of design.

4. CONCLUSION

The application of artificial intelligence in the field of user interface (UI) design has become a trend and has had a profound impact on the user experience and design process. By analyzing user behavior and preferences, AI is able to personalize UI interfaces to enhance the user experience [35]. In addition, AI can optimize the design process, speed up development, and improve efficiency. Combined with augmented reality and virtual reality technologies, AI brings a more immersive experience to users, creating interactive and customized virtual environments.

In the future, with the continuous development of artificial intelligence technology, UI design will continue to develop in the direction of personalization and intelligence. People's expectations and demands for digital products will also continue to rise, and UI design will continue to play an important role in bringing richer, personalized and intelligent experiences to users [36]. However, we also need to be mindful of the challenges AI may face in UI design and continue to explore solutions to drive progress and development in the field.

In general, artificial intelligence has become an important driving force for UI design, which provides designers with more opportunities for innovation and development, and also brings more quality and personalized experiences to users. With the continuous progress of technology and the continuous expansion of applications, we are confident that the future UI design will be more intelligent, personalized, and better meet the needs and expectations of users.

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