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User Behavior Analysis on Websites With the Help of Artificial Intelligence Algorithms and Application Examples

Abstract

This article explores the applications of artificial intelligence in the field of user behavior analysis on websites and the potential of this technology. Artificial intelligence algorithms are widely used in various fields such as personalized content presentation by analyzing user behavior, enhancing customer experience through chatbots and virtual assistants, improving user experience, optimizing marketing campaigns, increasing customer satisfaction, and detecting fraudulent activities. The article explains how various technologies of artificial intelligence, including methods such as machine learning, deep learning, and natural language processing, are used to predict and analyze the behavior of website users. It also discusses the potential opportunities of artificial intelligence for more accurate analysis and prediction of user behavior in the future. The article highlights the growing role of artificial intelligence in user behavior analysis and shows what strategic advantages advances in this field provide for businesses.

Keywords: *artificial intelligence, user behavior, website analytics, machine learning, user behavior analysis*

Introduction

The extensive application of artificial intelligence (AI) in the analysis of user behavior on websites has been studied from various aspects in the existing literature. An analysis of previous works shows that the main focus is on the classification and prediction of user behavior. For example, the application of machine learning and deep learning technologies is recognized as an effective approach to provide personalized content and product recommendations based on users' past activities. This approach is especially widespread in the field of e-commerce and is widely used to increase customer satisfaction.

Research on the application of artificial intelligence to analyze user behavior on websites is extensive and has addressed the topic with various approaches. A review of previous works mainly emphasizes the role of AI in providing personalized content, improving user experience and achieving commercial goals. For example, it is shown how recommendations based on user behavior are applied to increase customer satisfaction on the Netflix platform. This article will examine how artificial intelligence is used in the analysis of user behavior on websites, which algorithms are used, and various application examples in this field (Shirinova, 2021).

Artificial Intelligence and User Behavior Analysis

The wide application of artificial intelligence (AI) in the analysis of user behavior on websites has been studied from various aspects in the existing literature. An analysis of previous works shows that the main focus is on the classification and prediction of user behavior. For example, the application of machine learning and deep learning technologies is recognized as an effective approach to provide personalized content and product recommendations based on users' past activities (Shirinova, 2021, s. 376). This approach is especially widespread in the field of e-commerce and is widely used to increase customer satisfaction.

Research on the application of artificial intelligence to analyze user behavior on websites is extensive and has addressed the topic with various approaches. When looking at previous works, the role of AI is mainly emphasized in providing personalized content, improving user experience and achieving commercial goals. For example, Gómez-Uribe and Hunt analyzed the effectiveness

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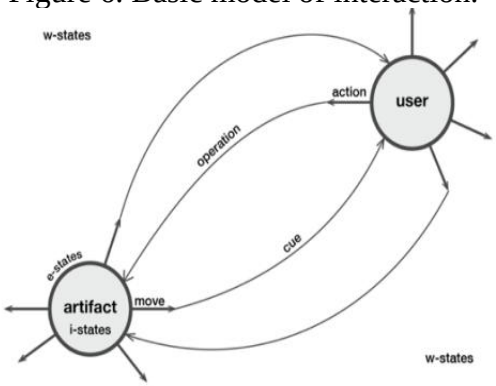
of recommendation systems on the Netflix platform and explained how recommendations based on user behavior can be applied to increase customer satisfaction. This study shows that personalized recommendations using AI offer content that is tailored to users' interests, which in turn keeps users on the platform longer (Maharramova, 2024, p. 12).

Another study was conducted by Riedl and Zanker, which explained how AI is applied in recommender systems across different sectors and how these systems are used to predict user behavior. They examined how AI is used in automated decision-making processes and to personalize the user experience, and presented various application examples in this area (Aslanzade, 2021, p. 194).

According to Janlert and Stolterman (Shirinova, 2021, p. 376), interaction can be defined as a user's action, understood as an operation by an artifact, and an "action" from the artifact. See Figure 6.

Figure 6. Basic model of interaction.



Source: Janlert və Stolterman, 2014

A brief explanation of the model and its key concepts may be needed. First, as explained in (Shirinova, 2021, p. 377), "states" are divided into two classes: internal states, or i-states for short, are functionally critical internal states of an artifact or system. External states, or e-states for short, are operationally or functionally relevant states of the interface, artifact, or system exterior that are observable by the user. Furthermore, world states, or w-states for short, are states in the world that are outside the artifact or causally related to the operation of the system (Shirinova, 2021, p. 378). The model details the activity on both the artifact and the user side. For example, states change as a result of user action or an operation triggered by the movement (action) of the artifact. These actions appear as a cue to the user. These cues are perceived by the user as either e-state changes or w-state changes. The model is intended as a tool for analyzing any form of human-artifact interaction. This serves our purpose well in exploring the relationship between automation and interaction. Based on the model, we can now define any form of "automation of interaction" as the removal of a pair of actions and actions from an interaction that leads to the same or similar outcome. We first focus on the extreme forms of the relationship between interaction and automation, namely, the absence of automation (full interaction) and the absence of interaction (full automation)

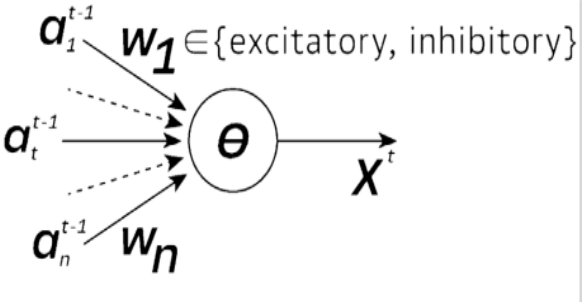
The Main Algorithms Used

In the development of artificial intelligence, there is a large field called machine learning, which studies the methods of building self-learning algorithms. In the absence of a clear solution to the problem, self-regulation and self-learning are required, and instead of finding the right solution, it is rational to create a mechanism capable of inventing, developing and suggesting the method itself to find the solution. Neural networks have advantages over traditional regression models and include the ability to approximate any continuous dependence function with automatic learning, universal work with different scales for measuring dependent and independent variables (Usubov, 2021, p. 385).

For a consumer who intends to order, buy or use goods only for personal, family or household needs, it is important to find motives, interests and triggers to make a purchase decision that is convincing in the new reality. Rational and emotional needs change under the influence of emerging new interests, immersion in virtual or hybrid reality, self-development and finding a balance between the new generation Y, Z, A, ecological, biological, anthropological, psychological, psychological, etc. moral, spiritual and technological information content of the world (Jafarov, Aliyeva, & Shirinli, 2020).

Neural network (artificial neural network ANN) was developed in 1943 by scientists Warren McCulloch and Walter Pitts and is presented in the form of a mathematical model, software or hardware implementation, built by analogy with the organization and functioning of networks of nerve cells (Fig. 7).

Figure 7. Warren McCulloch and Walter Pitts neural network model (Usubov, 2021, p. 6).



In the model, X is the input vector of parameters. W is the vector of weights (generally the matrix of weights). From the point of view of machine learning, an artificial neural network is a special case of using pattern recognition methods, discriminant analysis (interpretation of intergroup differences, classification of observations into groups), clustering methods (graphical, hierarchical). From the position of artificial intelligence, ANN, the philosophical movement of connection or the approach in the field of artificial intelligence, cognitive science, neurobiology, psychology and philosophy of consciousness, is considered a platform for modeling mental or behavioral phenomena with simple elements. From this point of view, ANN is characterized by the basic structural content of modeling natural intelligence using computer algorithms (Usubov, 2021, p. 387).

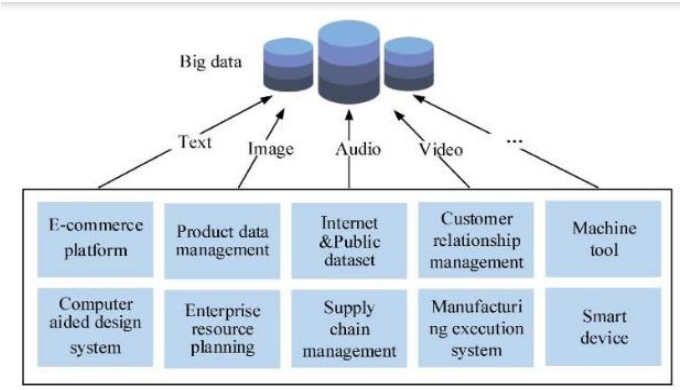
Researchers Skorobogatikh and Musatova focus on certain segments of consumers who are constantly in contact (connected consumers) and are active on the Internet. “Digital” consumers have constant access to the Internet (smartphones, tablets), but can represent different strata (income) groups, differ in age and social status (Kumar, 2019, p. 85). In the general group of “digital” consumers, we can distinguish the most active, young and creative consumers (Young Active Consumers) who participate in online sales processes. It should be noted that these consumers mainly live in cities, are well-educated, have high personal and total incomes.

The most active consumers are people aged 30-39 (32.4% of total consumption at the end of 2019). If in 2020 millennials dominated the structure of the working-age population (42.8%), then by 2036 their share will decrease to 40%, while the share of Generation Z in the labor force will increase from 15.2% to 29.7%. It is logical to assume that by 2029, the “alpha” generation, those born in 2013 and younger, will reach working age. Generation A is projected to constitute 16.6% of working-age Russians, marking a significant demographic shift that will influence the consumer market, societal needs, and prevailing attitudes. This emerging generation is likely to bring new priorities and expectations shaped by their upbringing in a highly digital, interconnected world. As digital natives, they may demand greater technological integration, personalized experiences, and sustainability-focused products and services. These changes will require businesses and policymakers to adapt to the evolving preferences and challenges posed by this influential cohort (Teymurov, 2023, p. 21).

Experts note that the application of neural networks is limited by the complexity of initial training, the high cost of building an optimal network architecture, the need to collect a large amount of data for building a training and testing sample, and the lack of knowledge. For most enterprises that use standard quantitative and qualitative marketing research and use mathematical analysis methods, problem solving is not always effective in a dynamically changing situation (Teymurov, 2023, p. 11). The introduction of neural networks into research activities will increase the level of cost savings for consumer research, free up specialists, and ensure the development of the most reliable forecasting model for effective interaction with customers and increasing the competitiveness of the company (Tewari, Pant, 2020, p. 17).

Understanding user behavior is essential for creating user-centered designs that meet the needs and expectations of target audiences. By analyzing user interactions, designers can identify usability problems, optimize user flows, and adapt designs to match user preferences, ultimately improving the overall user experience.

Figure 8. The Role of AI Algorithms in User Behavior Analysis



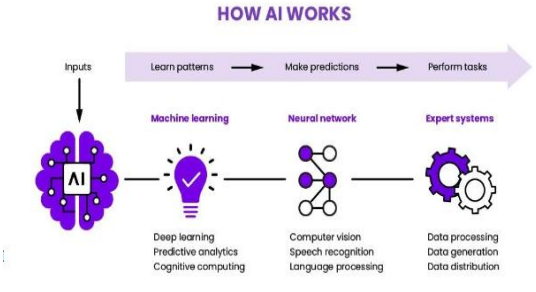
Source https://www.linkedin.com/pulse/how-ai-algorithms-used-analyze

AI algorithms collect and process large amounts of user data from a variety of sources, including website analytics, user feedback, and user interactions. By combining data from multiple touchpoints, AI algorithms provide a comprehensive view of user behavior, allowing designers to identify patterns and trends across different user segments (Huseynov, 2020, p x. 2).

AI algorithms use machine learning techniques to identify patterns and correlations within user data, such as common navigation paths, frequently accessed content, and user preferences. By recognizing patterns in user behavior, AI algorithms uncover insights that are not visible through manual analysis and help designers more effectively understand user needs and preferences.

AI algorithms use predictive analytics to predict future user behavior based on historical data and trends. By analyzing past user interactions and preferences, AI algorithms can predict user actions, preferences, and needs, allowing designers to proactively address user requirements and optimize design elements accordingly.

Figure 9. AI Applications in User Behavior Analysis



Source: https://intellipaat.com/blog/fraud-detection-machine-learning-algorithms/

AI algorithms power personalized recommendation engines that suggest relevant content, products, or services based on individual user preferences and past behavior. By analyzing user interactions and preferences in real time, AI algorithms provide personalized recommendations that enhance user engagement and satisfaction.

AI algorithms segment users into distinct groups based on shared characteristics, behaviors, or preferences. By segmenting users, designers can tailor design elements, content, and features to meet the specific needs and preferences of each user segment, maximizing relevance and engagement.

AI algorithms perform deep behavioral analysis to uncover user intent, motivations, and pain points. By analyzing user interactions, mouse movements, and engagement patterns, AI algorithms provide insights into user behavior, allowing designers to optimize user flows, eliminate friction points, and improve the overall user experience (Vahidli, 2021, s. 386).

AI algorithms can exhibit bias or unintended discrimination based on the data they are trained on. Designers should mitigate algorithmic bias by providing diverse and representative data sets, implementing fairness-aware algorithms, and regularly testing and monitoring algorithm performance.

As AI technologies continue to evolve, the capabilities of AI-driven user behavior analysis will expand, allowing designers to gain deeper insights and more accurately predict user needs. Advances in machine learning, natural language processing, and predictive analytics will further enhance the effectiveness and accuracy of AI algorithms for user behavior analysis (Vahidli, 2021, s. 387).

Despite the increasing role of AI in user behavior analysis, human judgment and empathy remain critical in the design process. Designers must balance insights from AI-driven analysis with human intuition, empathy, and creativity to create truly user-centered designs that resonate with users on an emotional level.

Application Examples of Artificial Intelligence

Artificial intelligence algorithms analyze users' past behavior and interests on a website to provide personalized content. For example, on e-commerce sites, artificial intelligence algorithms analyze information such as the products the user has viewed, searches, and items in their shopping cart. Based on this analysis, other products and services that the user may be interested in are suggested. Platforms like Netflix and YouTube also use artificial intelligence to offer users content that is relevant to their interests. E-commerce platforms like Amazon use artificial intelligence algorithms to analyze users' past shopping behavior, viewing history, and search criteria. For example, after a user searches for "camera," Amazon sends that user product suggestions related to cameras. This approach helps increase sales by increasing the product choices that are relevant to the user's interests.

Artificial intelligence plays a significant role in the development of chatbots and virtual assistants. These technologies provide real-time assistance to users on websites and mobile applications and interact with them interactively. For example, in the banking and customer service sector, chatbots answer user queries, solve problems, or make suggestions. Artificial intelligence-based chatbots understand and respond to user questions using natural language processing (NLP) technology. A virtual assistant named Erica, developed by Bank of America, assists customers with banking transactions. Using artificial intelligence and natural language processing technology, Erica answers customer questions, checks account balances, arranges bill payments, and provides users with financial advice. This improves the customer experience, prevents time loss, and increases customer satisfaction.

Artificial intelligence allows you to optimize the design and functionality of websites to improve the user experience. Algorithms analyze how users behave in different sections of the site and determine the most clicked or interesting pages. Based on this data, the interface of websites is optimized and the user experience is improved. For example, platforms such as Amazon and eBay

are constantly improving the layout and interface design of their websites with the help of artificial intelligence. Netflix uses artificial intelligence to create personalized content recommendations for each user. The user's viewing history, genre preferences, and ratings are analyzed. For example, if a user often watches romantic comedies, Netflix suggests new movies and series in that genre to that user. Such personalized recommendations lead to users spending more time on the platform and extending their subscription period (Johnson, & Lee, 2021).

Artificial intelligence is widely used to increase the effectiveness of marketing campaigns. This technology analyzes users' behavior, interests, and shopping habits to create targeted ads and campaigns. For example, Google and Facebook aFdvertising platforms analyze users' personal information and online behavior through artificial intelligence algorithms and target ads according to their interests. This approach allows ads to be more effective and optimize advertising costs. Facebook Ads uses artificial intelligence algorithms to help advertisers accurately identify their target audiences. For example, a restaurant wants to target its advertising to people who live in the area, are in a certain age group, and are interested in healthy food. Facebook Ads analyzes this data and delivers the ad to that audience, thus increasing the effectiveness of the campaign and optimizing costs.

Artificial intelligence is also used to improve customer satisfaction. For example, user comments and reviews are analyzed using natural language processing algorithms to determine their satisfaction level. Based on this information, businesses can identify and resolve customer problems more quickly. As another example, quick-service food establishments use AI-based systems to measure and improve customer satisfaction. TripAdvisor uses AI algorithms to analyze hotel and restaurant reviews. It automatically identifies positive or negative opinions in user comments and calculates the customer satisfaction level of each establishment. This approach helps users make better choices and businesses improve their services.

Artificial intelligence is widely used to detect fraudulent activities on websites, including cyber attacks and fraud attempts. Algorithms analyze anomalies in user behavior to detect and warn of potentially dangerous activities. For example, in the fields of finance and banking, AI systems reduce the risk of fraud by monitoring suspicious transactions and actions in users' account data. PayPal and other payment platforms use AI-based fraud detection systems to protect user accounts. For example, if a user's account is charged with an unusually large amount and this transaction is not consistent with the user's usual behavior, the system automatically blocks this transaction and warns the user. Such measures are effective in preventing cyberattacks and fraud attempts.

Conclusion

The application of artificial intelligence (AI) technologies in the analysis of user behavior on websites creates broad opportunities for businesses to succeed in the modern digital world. Through technologies such as machine learning, deep learning and natural language processing, it is possible to understand user behavior more deeply, provide personalized content and improve user experience. The use of artificial intelligence in areas such as e-commerce, banking, media and marketing offers various advantages such as increasing customer satisfaction, increasing the effectiveness of marketing campaigns and detecting fraudulent activities. The examples presented in this article show that artificial intelligence technologies are a powerful tool for increasing the competitiveness of businesses and increasing user satisfaction. In the future, with the development of artificial intelligence, more advanced methods and approaches will emerge in the field of analyzing user behavior on websites. This will create additional opportunities for businesses to make better decisions and implement more effective strategic planning. Thus, the application of artificial intelligence is not only a technological innovation, but also a necessary tool for achieving success in the digital world

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