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APPROACH TO THE INTELLIGENT AGENTS APPLICATION IN E-COMMERCE SYSTEMS

Introduction. *This paper presents the analyze of main consumer behavior models in modern e-commerce systems, such as electronic consumer decision process model, research online purchase offline concept, also shown architectural solutions of e-commerce systems, including microservice architecture. The application of artificial intelligence (AI) based on large language models in e-commerce is proposed. The main functions of these models include text generation, acting as a 24/7 assistant, and analytics. Specifically, the user cases for store owners include the automatic generation of product descriptions, keywords, and categories, as well as analytics in areas such as customer feedback, user requests, searches, and shopping patterns.*

The purpose of the paper is to consider the possibility of use intelligent agents such as chatbots in an e-commerce system to meet customer needs, increase sales and provide personalized information.

Results. *The proposed approach demonstrates that AI models based on large language models can be applied to automate the generation of product descriptions, keywords, categories, and to gain insights into customer feedback, user requests, searches, and shopping patterns. In summary, this paper provides a comprehensive analysis of various consumer behavior models, architectural solutions, and the potential benefits of implementing AI-based solutions in the e-commerce industry.*

Conclusions. *The results of using intelligent agents in an e-commerce system include the ability to handle a large volume of customer queries simultaneously, provide support, and improve customer satisfaction and retention rates. The use of an intelligent agent in the sales process can also help to recommend products based on the customer's preferences and*

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browsing history, increasing the likelihood of a sale. The use of microservice architecture in a web application for an online store allows for independent scalability of components and the ability to build a system using different programming languages.

Keywords: *e-trade, intelligent agents, consumer behavior model, e-commerce system.*

INTRODUCTION

As a result of the Internet general popularization and the Web technologies worldwide implementation, more people have begun to abandon queues in favor of making payments and purchases across the Internet. In connection with total globalization and computerization, any commercial transactions are increasingly taking place on the Internet on specialized web.

Traditional models of consumer behavior in a regular store are not use when buying online due to the e-commerce specifics. Some features are characterized primarily by the absence of physical attributes of the store, such as the goods cleanliness and the trading floor, the entering convenience and the store location, and also emotional and psychological factors that affect the subjective consumer opinion. And on the Internet, the trust factor to the e-stores, products, transaction are very important.

All this leads to changes in consumer behavior models. The emergence and spread of the Internet also cannot be viewed in a detached way, so the models discussed below are a synthesis of the offline and online behavior.

This paper provides an in-depth analysis of various consumer behavior models that are commonly used in modern e-commerce systems. The author discusses the electronic consumer decision process model, which outlines the various stages that a consumer goes through before making a purchase online.

In addition to discussing consumer behavior models, the paper also explores various architectural solutions for e-commerce systems. Specifically, the author provides an overview of the microservice architecture, which is becoming increasingly popular due to its scalability and flexibility.

Furthermore, the paper proposes the application of artificial intelligence (AI) based on large language models in e-commerce. Store owners can benefit from these AI models by automating the generation of product descriptions, keywords, and categories, as well as gaining insights into customer feedback, user requests, searches, and shopping patterns.

Overall, this paper provides a comprehensive analysis of various consumer behavior models and architectural solutions for e-commerce systems. It also highlights the potential benefits of implementing AI-based solutions in the e-commerce industry.

The purpose of the paper is to explore the use of intelligent agents such as chatbots in an e-commerce system to meet customer needs, increase sales and provide personalized information.

CUSTOMER BEHAVIOR MODELS

The most famous customer behavior models consider additional factors, such as consumer motives, awareness and independence of choice, satisfaction, and the influence of marketing and advertising. Rational models are based on the concept of “economic man”, while irrational models utilize behaviorism and emotional appeals

[1–3]. Motivated consumer models focus on understanding consumer motives to stimulate choice, while conformist consumer models emphasize social identity and fitting in with social norms. Consuming consumer models prioritize the act of consumption as a symbol of achievement, and ethical consumer models promote environmentally friendly and ethically pure products and companies [4–5].

One of these models is eCDP model, or Electronic Consumer Decision Process Model, consists of five stages of decision-making: problem recognition, information search, alternative evaluation, purchase, and outcomes, as illustrated in Fig. 1 [6].

During the first stage of the purchasing decision process, known as problem recognition, the consumer becomes aware of the type of product they need. In the second stage, information search, the consumer utilizes search engines to find the most optimal electronic seller based on specified criteria. Payment method is not initially set as a search criterion, but it may become important during the purchase stage. However, some online stores and aggregators offer the option to choose payment or delivery as a search criterion during the information search stage, causing a shift in the eCDP model.

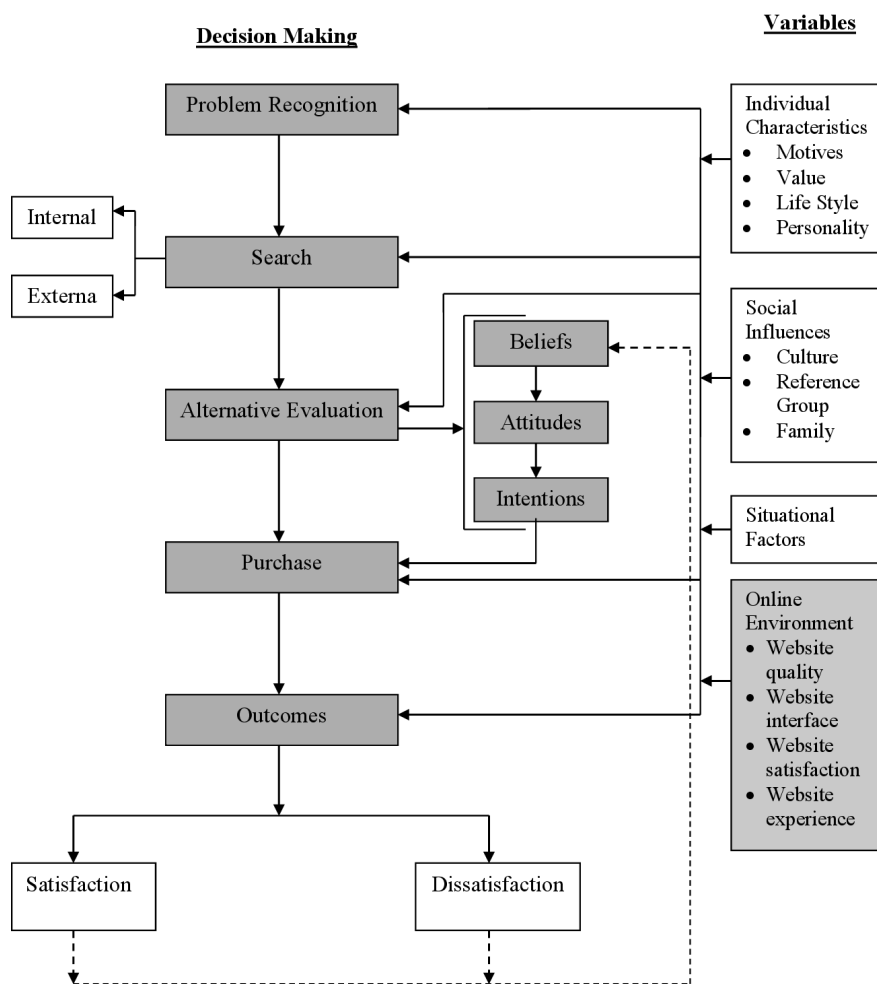


Fig. 1. The schema of the eCDP model [1]

Alternative evaluation often happens simultaneously with information search. At this stage, the information presented on the website plays a crucial role in determining the site's reliability for making a transaction, and payment method is also evaluated.

The purchase stage is critical in the eCDP model, where ease and convenience of the transaction become significant factors. Lengthy registration and order processing time may deter consumers, causing them to abandon their cart and return to the alternative evaluation stage to find a more convenient payment method.

In the era of digital transformation, the information consumer model has emerged, where the decision-making process is entirely reliant on electronic devices used for choosing products or services in digital markets [7–8].

SOFTWARE SOLUTIONS FOR CREATING E-COMMERCE SYSTEMS

Creating electronic commerce systems requires the use of appropriate software and architectural solutions to ensure high performance, scalability, and security. There are numerous platforms, frameworks, and tools used for creating electronic commerce systems. For example, technologies such as Java, PHP, Ruby on Rails, Python, Node.js and others are used for developing web applications. One important aspect of e-commerce architecture is ensuring system security. In this context, technologies such as SSL encryption, two-factor authentication, protection against DDoS attacks and more are used.

Additionally, it is important to ensure system scalability and performance. Solutions such as caching, horizontal scaling and other performance optimization methods are used for this purpose. Some well-known platforms for creating e-commerce systems include Magento, Shopify, WooCommerce, OpenCart, PrestaShop, BigCommerce and others. They provide many tools for creating and managing an online store, including product management, order management, payment and shipping functionality.

However, the choice of a specific platform or framework depends on the specific needs and requirements of the project, so it is important to conduct a careful analysis and choose the most suitable solution.

Consider some of the CMS (content management system):

– *WooCommerce system*

WooCommerce is a free plugin for the WordPress content management system that allows you to create and manage an e-commerce store [9]. It is a reliable and efficient tool for those who want to start their own e-business. This plugin allows you not only to create products and services, but also to set up their prices and taxes, accept payments, send orders, and much more. However, its advantages are not limited to this.

One of the main advantages of WooCommerce is its ease of use. This is very important because not every user may have experience in creating an e-commerce store. WooCommerce is designed in such a way that even beginners can quickly understand how to use it. In addition, WooCommerce has a huge number of extensions and plugins that allow you to expand its capabilities and make it work in any market. Thanks to these plugins, you can add new features and tools that increase the efficiency of WooCommerce.

In addition, WooCommerce has built-in support for multilingualism and international shipping. This is especially important for those who have international customers and are considering expanding their business to new markets. Thanks to these features, you can create an e-commerce store that will work in any market and be convenient for different types of customers.

Finally, we shouldn't forget about the large community of WooCommerce users and developers. This community helps to solve problems and could provide support in case of difficulties. Also, it provides a variety of themes and designs that help you create an e-commerce store that meets your needs and requirements.

In general, WooCommerce is a free and powerful tool for creating an e-commerce store based on WordPress. It allows you to create an effective and convenient store that will work in any market and ensure your business success.

Shopify is a web-based e-commerce platform that allows you to create and sell online. It is a very popular service all over the world, used by thousands of entrepreneurs and companies. The main advantage of Shopify is that it allows you to create stores quickly and easily without the need for large expenditures on programmers and designers. In addition, it has a huge number of features and capabilities that allow it to work in any market and meet the needs of different types of customers.

– *Shopify e-commerce system*

Shopify has a very simple and intuitive interface that allows users to quickly create stores and list products on them [10]. It has a large number of themes and designs that help to create stores with different styles and meet the requirements of different types of customers. In addition, it has a huge number of features such as online payment, order processing, inventory monitoring, and much more. All of these features help to ensure that your store runs efficiently and provides customer satisfaction.

One of the main advantages of Shopify is its scalability. It can be used to create stores of any size, from small to large. In addition, it has a large number of extensions and plugins, which allows you to ensure that it works in any market and expand its capabilities. It also has a huge community of users and developers who provide support and help solve problems.

Finally, Shopify has built-in support for multilingualism and international shipping. This is especially important for those who have international customers and are considering expanding their business to new markets. Thanks to these features, you can create a store that will work in any market and be convenient for different types of customers.

All in all, Shopify is powerful and efficient e-commerce platforms that allows to quickly and easily create stores and keep them running in any market. It has a large number of features and capabilities that allow you to meet the needs of different types of customers and ensure their satisfaction.

– *OpenCart e-commerce system*

OpenCart is a free web-based platform for creating e-commerce stores. This platform allows to create and manage an e-commerce store by installing and configuring OpenCart on your server. OpenCart has a large set of features and capabilities that allows you to create stores of various sizes and complexity [11].

One of the main advantages of OpenCart is its ease of use. It allows users to quickly create stores and place products on them. OpenCart has a user-friendly and simple interface that allows users to quickly navigate and understand how to use this platform. In addition, OpenCart has its extensions and plugins that allow you to expand its capabilities and ensure that it works in any market.

OpenCart also has built-in support for multilingualism and international shipping. This is especially important for those who have international customers and are considering expanding their business to new markets. Thanks to these features, you can create a store that will work in any market and be convenient for different types of customers.

OpenCart has a large community of developers and users who provide support and help solve problems. This community also provides a variety of themes and designs that help to create stores with different styles and meet the requirements of different types of customers. In addition, OpenCart has a huge amount of documentation and support, which allows users to quickly find answers to their questions and problems.

In general, OpenCart is a free and powerful web platform for creating an e-commerce store. It has a large number of functions and features that allow you to meet the needs of different types of customers and ensure their satisfaction.

– Saleor e-commerce system

Saleor is a free, open-source e-commerce platform that provides powerful and innovative capabilities for developing stores of any complexity and size [12].

One of the main advantages of Saleor is its speed and performance. It uses modern technologies such as GraphQL and React, which allows you to create efficient and fast stores. In addition, Saleor has a large number of extensions and plugins, and also what is most impactful — powerful backend and freedom to build your store upon it which allows it to work in any market and expand its capabilities.

Saleor has a very powerful and modern backend base and very extensive and detailed documentation of approaches to frontend development, respectively that allows you to create stores in very modern, efficient and flexible way.

It has a large capabilities of visual customization that help to create stores with different styles and meet the requirements of different types of customers. In addition, Saleor has a huge number of features, such as online payment, order processing, inventory monitoring and much more.

Saleor has built-in support for multilingualism and international shipping, which allows you to keep your store running efficiently and ensure customer satisfaction from different countries. It also has a large community of developers and users to provide support and help solve problems.

All in all, Saleor is a powerful and efficient e-commerce tool that allows you to build modern, flexible stores and keep them running in any market. It has a large number of functions and features that allow you to meet the needs of different types of customers and ensure their satisfaction.

One of the key capabilities of an e-commerce software framework is the ability to expand and customise according to the needs of the client. Thus, an e-shop can be modified and customised to meet specific business needs. For example, the ability to add new features, customises the user interface, and changes the design to match the business brand. This allows businesses to create a unique e-commerce store that meets their needs.

While Content Management Systems (CMS) have been popular for creating and managing website content, they may not always be sufficient to handle complex business processes. E-commerce systems, for example, require features such as customer support, product recommendations, and automated product verification, which may not be readily available in a standard CMS. This is where intelligent agents and microservice architecture can be used to enhance e-commerce systems.

Intelligent agents are computer programs that can perform tasks autonomously without human intervention. In e-commerce systems, they can handle a large volume of customer queries simultaneously, provide support, and improve customer satisfaction and retention rates. They can also recommend products based on the customer's preferences and browsing history, increasing the likelihood of a sale.

The use of intelligent agents and microservice architecture in e-commerce systems can enhance customer support, product recommendations, and automated product verification while enabling independent scalability and creating a strong connection between technical products and business opportunities.

ARCHITECTURAL SOLUTIONS IN E-COMMERCE SYSTEMS USING INTELLIGENT AGENTS

As an AI language model, intelligent agents can play a valuable role as an assistant in the e-commerce system. By leveraging natural language processing (NLP) and machine learning algorithms, chatbots can understand the intent of the customer's query and provide relevant responses quickly and accurately.

One of the key benefits of using intelligent agents in an e-commerce system is that they can handle a large volume of customer queries simultaneously, without any delays or downtime. This means that customers can get the support they need, whenever they need it, without having to wait for a human agent to become available. This can improve customer satisfaction and retention rates.

Intelligent agent can also assist in the sales process by recommending products based on the customer's preferences and browsing history. By analyzing the customer's behavior on the e-commerce site, chatbots can suggest products that are likely to interest the customer, increasing the likelihood of a sale.

Furthermore, agent can provide personalized recommendations and promotions to customers, based on their past purchases and preferences. This can help to improve customer loyalty and increase the likelihood of repeat business. Intelligent agent can be an effective assistant in an e-commerce system, providing 24/7 support, handling a large volume of customer queries, assisting in the sales process, and providing personalized recommendations and promotions to customers.

Diagram in Fig. 2 represents system architecture for a product verification system that uses an AI component to process product information provided by a Human actor and verifies it against a database using a Verification_System component.



Fig. 2. The architecture system of product verification

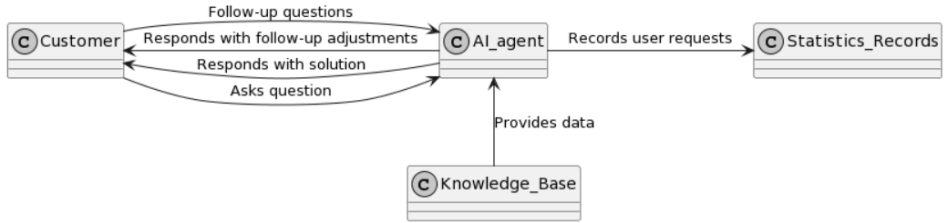


Fig. 3. The automated intelligent agent e-commerce system

The diagram consists of several components, an actor and arrows representing interactions between them.

Here is a brief description of the components:

- AI: represents an Artificial Intelligence system that is responsible for processing the product image and characteristics provided by the Human actor;
- MetaDataBase: represents a metadata database that stores information about the product, such as category, description and keywords;
- DataBase: represents a database that stores all the product information, including verification results;
- Verification_System: This component represents a system that verifies the product information sent by the AI component against the database.

Fig. 3. shows the automated intelligent agent e-commerce system that uses a knowledge base and statistical data to answer questions posed by clients.

The following elements are involved in the system's operation.

1. Clients: system users who ask questions.
2. AI agent: an automated intelligent agent that responds to questions and processes client requests.
3. Knowledge base: storage of information used by the agent to obtain the necessary data to answer client questions.
4. Statistical records: a database used to record statistical data related to client requests.

When a client asks a question, it is sent to the automated intelligent agent. The agent uses the knowledge base and statistical data to find the most suitable answer to the client's question.

If the client has additional questions or needs further clarification, they can ask the agent. The agent uses this data to clarify their answer and provide more accurate information.

All information about client requests and agent responses is recorded in the statistical records database. This data is used for analysis and to improve the system's performance in the future.

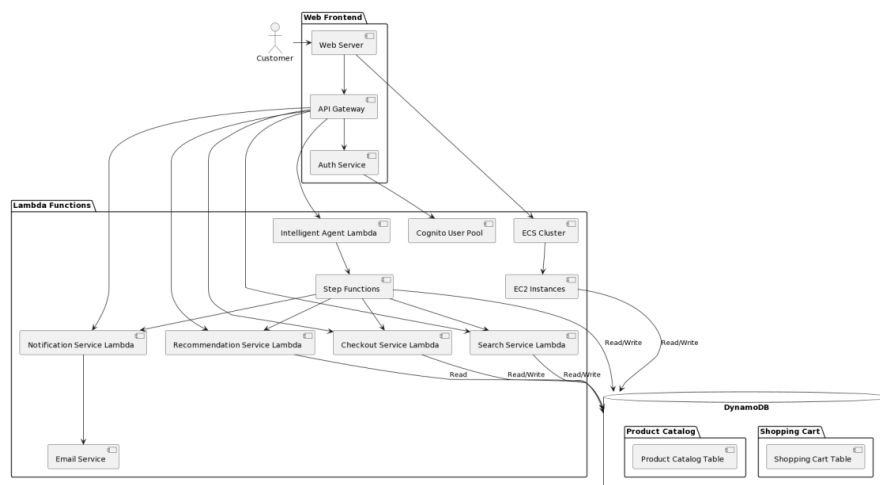


Fig. 4. The microservice architecture of a web application for an online store

Thus, the system provides an automated process for answering client questions using a knowledge base and statistical data, which allows for improved quality and efficiency of client service.

These systems are included in the microservice architecture of a web application for an online store.

Microservice architecture is a kind of service-oriented architecture, which is built on the basis of loosely connected services with limited contexts.

One of the characteristics of microservice architecture is the component representation through services. A component is a system element that can be independently replaced and scaled. Components as services allow for independent scalability — each service has the ability to be scalable independently of other parts of the application. In addition to componentity, the microservice architecture is characterized by such a property as heterogeneity. Heterogeneity is the ability to build a system using different programming languages.

In a microservices approach, teams should be organized based on business capabilities: an order team, a catalog team, and so on. Each team should have specialists with the necessary knowledge of technologies (interface, server part, DBA, QA). This gives each team enough knowledge to focus on creating specific parts of the application — microservices.

In the case of microservices, the team must be responsible for their product throughout its entire lifecycle, including development, maintenance, and decommissioning. This approach creates a product mindset that means a strong connection between a technical product and its business opportunities. That is, a direct relationship is created: how the application helps its users to expand their business opportunities.

The diagram (Fig.4) depicts the actors and components of the system. The actor is the “Customer” who uses the web application to purchase products.

The web server is the first layer of the application, which processes incoming requests from the customer. The API Gateway provides the communication between the web server and other services such as authentication, search, recommendations, order processing, notifications etc.

The authentication service is used to authenticate the user and authorize them to perform operations within the application.

DynamoDB is the database that contains the “Shopping Cart Table” and “Product Catalog Table” used by various services.

Lambda functions are microservices that handle various requests and operations. Among the lambda functions are the search, recommendation, order processing, and notification services. The intelligent agent is a service that uses Step Functions to coordinate and manage the flow of service execution.

Step Functions is an orchestration service that allows you to create and manage processes using states, transitions, and branching.

Cognito User Pool is a service for managing users and their access rights.

ECS Cluster is a tool used to manage containers.

EC2 Instances are virtual machines used to run lambda functions and manage the DynamoDB database.

Overall, this system provides the complete cycle of the online shopping process, from searching and recommending products to order processing and delivery status notifications.

PROTECTION OF CONFIDENTIAL DATA

One of the most important and complex tasks in information security is the protection of confidential data. In the case of confidential data, a variety of solutions using encryption technologies are usually used, but in recent years, there has been an increase in interest in another technology — tokenization, which reduces the risks for confidential data. Applications can store, use and make transactions using only a token and without putting real data at risk. Although some operations require access to real data, tokenization minimizes their use. The key advantage of tokenization is the ability to store confidential data in only one place — on the tokenization server, where it is securely stored in encrypted form. This reduces the risk compared to encryption, which makes sensitive data available in multiple locations [13].

That is why the paper proposes a variant of saving the JWT token, which allows you to protect yourself from typical attacks on the server using an access token, which significantly reduces risks and simplifies compliance with some requirements of security standards.

JSON Web Token determines the particular structure of information that is sent over the network. It is presented in two forms — serialized and deserialized. The first is used directly to transfer data with requests and responses. The other one reads and writes information to the token, that is, the deserialization process is performed [14]. This article has covered the persistence of a serialized form, which typically happens in cookies or browser local storage. Local Storage — the method is dangerous because it is exposed to attacks such as XSS [3]. Cookie is a simple storage of a token, often threatens with a CSRF attack and does not protect against XSS attacks [15–16].

The proposed in [17] token saving approach allows one to protect against the two most frequent types of attacks and to organize a more reliable security algorithm. Each of these methods has drawbacks that can be avoided by storing the token in a local variable inside the closure.

When using the application, the user may encounter some problems: a quick end of the session (the JWT expires) and the session will not be saved upon re-entry (the system does not save the JWT token on the user's side). To solve these problems, you can give a refresh token that can be used for the API and that can be saved between user sessions.

This token is part of the authentication process along with the JWT. The server stores the refresh token and associates it with a specific user in its database. On the client-server, you need to connect the application to create the update and get a new JWT before the previous JWT token expires.

The refresh token is sent as HttpOnly and is automatically sent by the browser when using the API.

CONCLUSIONS

With the increasing popularity of e-commerce, it is essential to optimize the structure of e-trade systems to enhance the customer experience. To achieve this, machine learning and artificial intelligence can be utilized to identify patterns and trends, as well as to integrate intelligent agents and other algorithms to improve the speed and efficiency of e-commerce platforms.

Traditional models of consumer behavior used in regular stores cannot be applied to online purchases due to the absence of physical attributes such as store location and emotional factors that affect subjective opinions. As a result, new consumer behavior models must be developed to understand the various stages that a consumer goes through before making a purchase online. Additionally, microservice architecture is becoming increasingly popular due to its scalability and flexibility.

This paper proposes that AI models based on large language models can be applied to automate the generation of product descriptions, keywords, categories, and to gain insights into customer feedback, user requests, searches, and shopping patterns. In summary, this paper provides a comprehensive analysis of various consumer behavior models, architectural solutions, and the potential benefits of implementing AI-based solutions in the e-commerce industry.

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ПІДХІД ДО ЗАСТОСУВАННЯ ІНТЕЛЕКТУАЛЬНИХ АГЕНТІВ В СИСТЕМАХ ЕЛЕКТРОННОЇ КОМЕРЦІЇ

Вступ. В статті надано аналіз основних моделей поведінки споживачів у сучасних системах електронної комерції, таких як електронна модель процесу прийняття споживачем рішення, концепція «шукай онлайн, купи офлайн» (ROPO), а також показано архітектурні рішення систем електронної комерції, включаючи архітектуру мікросервісу. Запропоновано застосування штучного інтелекту (ШІ) на основі великих мовних моделей в електронній комерції. Основні функції цих моделей охоплюють генерацію тексту, дію як помічника 24/7 і аналітику. Зокрема, для власників магазинів ці моделі забезпечують автоматичне створення описів продуктів, ключових слів і категорій, а також аналітику в таких сферах, як відгуки клієнтів, запити користувачів, пошук і моделі покупок.

Мета статті — розглянути можливість використання інтелектуальних агентів, таких як чат-боти, у системі електронної комерції для задоволення потреб користувачів, збільшення продажів і надання персоналізованої інформації.

Результати. Запропонований підхід демонструє, що моделі штучного інтелекту, основані на великих мовних моделях, можуть бути застосовані для автоматизації створення описів продуктів, ключових слів, категорій, а також для отримання інформації про відгуки клієнтів, запити користувачів, пошукові запити та шаблони покупок. Підсумовуючи, можна сказати, що в статті наведено комплексний аналіз різних моделей поведінки споживачів, архітектурних рішень і потенційних переваг впровадження рішень на основі ШІ в індустрії електронної комерції.

Висновки. Використання інтелектуальних агентів у системі електронної комерції забезпечує здатність цієї системи обробляти велику кількість запитів клієнтів одночасно, надавати підтримку та підвищувати задоволеність клієнтів. За використання інтелектуального агента в процесі продажу також може надаватися допомога щодо рекомендування продуктів на основі вподобань користувача та історії перегляду його покупок, підвищуючи ймовірність продажу. Застосування мікросервісної архітектури у веб-застосунку для інтернет-магазину дає змогу здійснювати незалежну масштабованість компонентів і можливість будувати систему з використанням різних мов програмування.

Ключові слова: система електронної комерції, електронна торгівля, інтелектуальні агенти, модель поведінки споживача.