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METHODS FOR ASSESSING SEARCH RELEVANCE IN ELECTRONIC COMMERCE SYSTEMS

Abstract. Topicality. The paper examines the process of developing an information search system for modern e - commerce solutions. with an assessment of the relevance of search results. Classic search engines, based only on the coincidence of keywords, often do not take into account the context and morphology of queries, synonyms and the weight of individual words, the degree of compliance of the results found with the user's expectations. Therefore, the creation of an intelligent search engine with an assessment of the relevance of search results, which is capable of take into account the user's intentions and adapt to their individual needs. The relevance of a query also has an indirect impact on information security, especially in the context of data processing by applications and systems, as irrelevant or anomalous queries can be a sign of potential cyberattacks. This fact increases the topicality of the study. **The subject of study** in the article is methods of increasing the relevance of search results based on the analysis of user queries and ranking of product characteristics. **The purpose of the article** is increasing the efficiency of search in information search systems of electronic commerce by implementing a modified method of relevance assessment. **The following results** were obtained. The influence of the level of relevance of queries on the level of information protection in information search systems, the features of the formation of user search needs, analysis of relevance assessment models, development and testing of an electronic commerce system with relevance assessment, which showed an improvement in search efficiency indicators, was considered. **Conclusion.** The use of relevance assessment methods for building search systems in the field of electronic commerce is an effective direction for improving the quality of information search services. The results obtained indicate the prospects for further research in the direction of adapting information search models to the specifics of online trading, improving ranking algorithms and integrating machine learning methods for personalizing the delivery of results.

Keywords: e-commerce, search engine, relevance, ranking, search efficiency, information protection, relevance assessment model.

Introduction

Problem relevance. In today's rapidly developing e-commerce environment, the effectiveness of an online store is largely determined by the quality and convenience of searching for products. Users expect to receive relevant search results in a matter of seconds, and any delay or inaccuracy in the output can lead to the loss of a potential buyer. The problem of search accuracy is especially relevant for large online stores with a wide range of products, where classic search methods often do not take into account the context, query morphology, synonymy, and the importance of individual words.

In a highly competitive environment, the quality of a search engine becomes one of the key factors affecting conversion rates, customer satisfaction, and business financial performance. The lack of a system for assessing the relevance of search results leads to users not finding the right products or receiving irrelevant results, which reduces the effectiveness of the platform as a whole. That is why creating an intelligent search engine with a relevance assessment mechanism is a pressing task for modern e - commerce solutions.

Literature review. An information retrieval system (IRS) is a complex set of software and hardware that provides the processes of collecting, storing, processing and issuing information in accordance with the information needs of users [1]. IRS perform the following operations:

document search;

analysis of document content;

construction of search images of documents (extraction of information from documents that is used by the system as knowledge about the document);

storage of searchable images of documents (information about documents);

analysis of user requests (information consumers);

search for relevant (corresponding) document requests;

providing links to documents to consumers.

The effectiveness of information search is determined by indicators that characterize the finding of relevant documents. They are divided into semantic (accuracy and completeness of search, information noise coefficient and loss coefficient) and technical and economic (search efficiency, cost and labor intensity of search) [2].

In today's information society, where data volumes are growing exponentially, finding relevant information is becoming a key task. That is why the development of effective search engines is one of the most important areas in the field of information technology [3].

Relevance in this context is defined as the degree to which a document corresponds to a user's information request. It can be both objective and subjective: on the one hand, there are formal criteria for correspondence, and on the other, there are individual user expectations that cannot always be accurately described mathematically. Therefore, modern search engines strive to combine formal algorithms with elements of adaptation to user behavior [4].

Search engines can be classified according to various criteria. Most often, systems focused on text data, multimedia resources or structured databases are

distinguished. According to the search principle, full-text systems that analyze the entire content of a document are distinguished, systems that work only with metadata, and hybrid solutions. Finally, according to the scope of application, search engines are divided into universal, specialized and corporate.

Online stores are designed to search for and sell specific products and services. They can be considered specialized ISPs, focused on searching a limited database of products, rather than a vast array of documents, as in search engines like Google.

Despite the above limitations, it should be understood that even within e-commerce there may be different approaches to organizing search: from simple search by product name to complex systems that take into account the semantics of the query and individual customer preferences [5].

Additionally, it is worth noting that the development of search engines is closely related to the evolution of natural language processing methods. If in the initial stages the search was reduced to a simple comparison of keywords, today semantic analysis is becoming increasingly important, which allows you to take into account the context of the query. This means that the system is able to recognize not only the literal coincidence of words, but also the semantic connections between them. This approach is especially important in the field of e-commerce, where the user can formulate the query in any form, for example: "comfortable running shoes" or "laptop for working with graphics."

Another trend is the integration of search engines with recommendation engines. Modern online stores not only provide the user with a list of products that match their query, but also offer additional options that may interest them. This is achieved through the analysis of behavioral factors: browsing history, previous purchases, time spent on pages. Thus, the search engine turns into a personalization tool that increases the likelihood of making a purchase.

An important aspect is also the evaluation of the effectiveness of search engines [6]. Traditionally, indicators such as completeness (the proportion of relevant documents that the system was able to find) and accuracy (the proportion of documents found that are actually relevant) are used for this. In the practice of e-commerce, these criteria acquire applied significance: if the search returns too many irrelevant results, the user may leave the site; if the system does not find the desired product, the store loses a potential customer. Therefore, the task of developers is to achieve the optimal balance between completeness and accuracy of the search.

In conclusion, we can say that information retrieval systems are not only a technical tool, but also an important element of user interaction with the information environment [7]. Their classification and development reflect general trends in information technology: from simple keyword search to intelligent systems capable of understanding user intentions and adapting to their individual needs.

The purpose of the research is the development and implementation of an information search system with an assessment of the relevance of search results for an online store based on the WordPress platform using the WooCommerce plugin. The main task is to create an adaptive search engine that can increase the accuracy and speed of results through the use of relevance assessment algorithms.

1. The influence of the level of relevance of queries on the level of information protection in information retrieval systems

Information protection in information retrieval systems is ensured by a comprehensive approach that includes technical means (antiviruses, firewalls, encryption), access control (authentication, authorization) and organizational measures (backup, logging, regulation). This allows you to prevent unauthorized access, hide data from attackers, and protect the system from malicious software and leaks [8].

Query relevance has an indirect impact on information security, especially in the context of data processing by applications and systems, as irrelevant or anomalous queries can be a sign of potential cyberattacks such as SQL injections or XSS.

Detecting suspicious activity. Security systems use relevance analysis to detect suspicious activity. Requests that are significantly different from normal, relevant user activity may signal a hacking attempt, vulnerability scanning, or other malicious activity.

Reducing the likelihood of accidental leakage of confidential information (CI). When search results are highly relevant, users find the information they need faster. This reduces the need to "dig" through a huge volume of insignificant data, where potentially confidential documents or data with restricted access that should not have been accessible to that user but mistakenly became visible to access control systems could accidentally get in.

Improving the efficiency of access control systems. Achieving high relevance often requires deeper analysis and categorization of data. This categorization process can facilitate more precise and granular enforcement of security and access policies, ensuring that even a highly relevant result is not served to a user who does not have the appropriate authority.

Reducing the need for "workarounds". If the official ISP returns irrelevant results, users may start searching for information in alternative, less secure ways (e.g., through personal correspondence, unsecured communication channels), which increases security risks. A relevant and effective system reduces this risk.

Finding reliable information. The more accurately a search engine understands your query and the better the relevance of the page to that query, the more likely you are to find the exact information you need, rather than misleading content. For example, the query "how to choose a screwdriver" will lead to articles with advice and comparisons, rather than a malicious link that the system might show if the relevance is low.

Reduce the risk of fraud. Poor relevance can be used to lure users to fraudulent sites. For example, if you search for "free antivirus" and the results show up first for sites that are actually phishing sites, this

indicates low relevance and a potential security risk.

Increasing trust in search engines. When search engines are successful at showing relevant results, they increase user trust. Users start to rely more on the search engine as a reliable source of information, which indirectly reduces the risk of encountering malicious sites in the first place.

Security system efficiency. High query relevance helps security systems (e.g. WAF, IDS/IPS) more accurately identify legitimate traffic and focus on real threats, reducing the number of false positives and increasing overall protection efficiency.

Understanding user intent. In the context of information security, understanding the true intent of the user behind a request (relevance) allows systems to provide relevant information and prevent data misuse, which is also part of an overall security strategy.

Thus, a high level of query relevance contributes to an overall improvement in data control and compliance with access policies, which indirectly strengthens information security, making the system more manageable and predictable, as any deviations from the norm can be quickly identified as potential threats. This does not replace the need for reliable software, technical and organizational protection measures, but complements them in terms of the human factor and efficiency of use.

2. Features of the formation of users' search needs in online stores

The search for goods in an online store is carried out by users within the framework of certain information needs, which are formed depending on the intentions and level of possession of information about the search object [9]. The need for search arises due to the need to access data about the product, including its name, functional properties, technical parameters, manufacturer, cost and other consumer characteristics. Users use the search system to optimize the process of orientation in the product range, reduce the time to search for the necessary information and reduce the number of intermediate operations when navigating the web resource.

The peculiarities of user behavior when searching for products determine the specific requirements for the search engine of an online store. For most users, it is typical to form a search query based on their own idea of the product, which does not always correspond to the terminology used in the product catalog. This complicates the process of processing the query and may lead to irrelevant results.

An important feature of users' behavioral characteristics is the expectation of receiving relevant information in the shortest possible time, which determines the need for a search system to function with minimal response delay, high accuracy of result generation, and the ability to process search queries of varying degrees of detail.

In the process of user interaction with the search engine of an online store, there is a tendency to reduce tolerance for search errors. In case of receiving irrelevant or incomplete results, users rarely reformulate the query, but instead stop interacting with the web resource, which ultimately results in the loss of a potential buyer. This indicates the need to ensure correct processing of variable forms of search queries, as well as adequate consideration of lexical, linguistic and contextual features of the formulation of user queries.

Thus, the effectiveness of the process of searching for goods in an online store is determined by the ability of the search engine to ensure the accuracy, completeness and logical formation of query results, as well as its compliance with the user's actual expectations.

3. Principles of operation of the information retrieval system

Any search engine operates on the basis of several key components. The central element is the indexing module, which performs data preprocessing. During indexing, the text is divided into separate units - tokens, which are then normalized by lemmatization. An important stage is the removal of so-called stop words, which do not carry a semantic load. The result of this process is an inverted index - a data structure that allows you to quickly find documents in which a certain term occurs. It can be represented as a formula (1)

$$I(t) = \{d_1, d_2, \ldots, d_1\}, \quad (1)$$

where $I(t)$ – the set of documents in which the term t occurs ; t – term (word or token) being indexed; $\{d_1, d_2, \ldots, d_1\}$ – documents containing the term t .

In addition to indexing, the query processing module plays an important role. It analyzes the text entered by the user, transforms it into an internal representation and compares it with the index. The final element is the user interface, which provides convenience in interacting with the system (see Fig. 1).

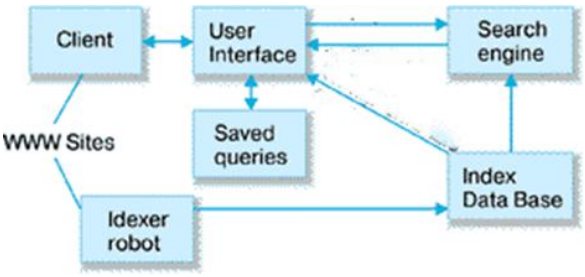

Fig. 1. General architecture of a search engine

4. Analysis of the relevance assessment model

Estimating relevance is a central task of any search engine. There are several models that define how the similarity between a query and a document is calculated [10].

Information retrieval (IR) is the process of finding relevant data or documents in response to a user query. Several IR models have been developed to date, resulting in search engines extracting and ranking information. These models fall into three main types: traditional models, user-centric models, and cognitive models. They are typically characterized by their

respective algorithms and performance. A detailed overview of each is provided below:

1. Traditional models. These models focus on the structural and computational aspects of information retrieval, optimizing the indexing, retrieval, and ranking of documents based on queries.

A) Boolean model. This is one of the earliest models that uses Boolean logic (AND, OR, NOT) to process queries and match them to documents. A document can be relevant or irrelevant depending on whether it satisfies the query conditions. Key features: retrieves documents based on an exact match to the query terms; the result is binary: relevant or not; does not allow partial matches or ranking documents by relevance.

B) Vector Space Model (VSM). Documents and queries are represented as vectors in a multidimensional space, where each dimension corresponds to a term [10]. Relevance in this case is determined by the cosine similarity measure (2):

$$sim(d,q) = \frac{\sum_i (w_{i,d} \bullet w_{i,q})}{\sqrt{\sum_i w_{i,d}^2} \bullet \sqrt{\sum_i w_{i,q}^2}}, \qquad (2)$$

where $w_{i,d}$ – the weight of the term in the document; $w_{i,q}$ – the weight of the term in the query.

One of the most common ways to determine weights is the TF - IDF method (term frequency – inverse document frequency), which takes into account both the frequency of a term in a document and its rarity in the collection (3):

$$w_{i,d} = tf_{i,d} \bullet \log\left(\frac{N}{df_i}\right), \qquad (3)$$

where $w_{i,d}$ – the weight of term *i* in document *d*; $tf_{i,d}$ – frequency of term *i* in document *d* (number of its occurrences) ; *N* – total number of documents in the collection ; df_i – the number of documents in which term *i occurs* ; $\log\left(\frac{N}{df_i}\right)$ – inverse document frequency, which reduces the weight of terms that occur frequently.

The model allows for partial matches and ranks documents by relevance.

C) Probabilistic model. This model is based on the idea of estimating the probability that a document is relevant to a query. It uses statistical methods to rank documents by their probability of relevance and provides more accurate ranking of results (see Fig. 2) [11]. Main features: documents are assigned relevance probabilities; common implementation: BM25, which refines term frequencies by normalizing document length.

			TF			TF-IDE		
Term	**DF**	**IDF**	***d*** **1**	***d2***	***d3***	***d*** **1**	***d2***	***d3***
car	18.16	1.6	27	4	24	44.5	6.6	39.6
auto	6.72	2.0	3	33	0	6.2	68.6	0
insurance	19.24	1.6	0	33	29	0	53.4	46.9
best	25.23	1.5	14	0	17	21		25.5

Fig. 2. Example of a table with TF - IDF calculation for a small collection of products

D) Clustering model. This model groups similar documents based on common features using unsupervised learning methods such as *K* -means or hierarchical clustering.

Key features: groups documents into significant clusters; improves efficiency by narrowing down relevant sets; helps manage large data sets.

E) Best Match Model. This model ranks documents by their relevance to a given query, often used in search engines to return the most relevant documents first. Key features: uses similar tools (e.g., cosine similarity or BM25); focuses on matching query terms with document content.

2. User-centric models. These models focus on the user's needs, preferences, and the context in which the query is performed. They aim to improve the performance of search engines by taking into account user interaction, intent, and satisfaction.

A) Query Expansion Model. This model expands a query by adding related terms, synonyms, or concepts derived from the user's previous searches or external sources. Key features: responds to vague and ambiguous queries; includes techniques such as automatic thesaurus generation or semantic analysis; helps find more relevant documents by expanding search queries.

B) Relevance Feedback Model. This model refines search results based on user feedback indicating the relevance of the documents displayed, and the system adjusts its search accordingly. Key features: refines search based on user feedback; feedback can be explicit (explicitly marking documents as relevant or not) or implicit (analyzing user behavior, such as number of clicks or time spent on documents); often integrates with other models, such as VSM.

C) Personalized Information Search Model. This model adapts search results based on user-specific data, such as historical behavior, preferences, location, or demographic information. Key features: customizes search results for each individual user; uses techniques such as user profiling and collaborative filtering; improves satisfaction by providing more relevant, personalized results.

3. Cognitive models. Cognitive models study how human cognition and mental processes influence information retrieval. They aim to develop systems that are consistent with human thinking, perception, and memory.

A) Cognitive Load Model. This model aims to minimize the mental effort required to process information. It aims to reduce cognitive load when performing information retrieval and retrieval tasks.

Key features: reduces cognitive strain by presenting information clearly; may involve simplifying interfaces and search algorithms; increases usability by reducing the mental resources required to perform tasks such as searching and reading.

B) User-centered cognitive model (mental model approach) . This model assumes that users must form a mental representation of the system and its functionality. Understanding these mental models can help in designing systems that better meet users' expectations.

Key features: focuses on aligning system behavior with users' mental models; helps predict what users expect from the system; takes into account how users improve their understanding of the system over time.

C) Information gathering model. This model assumes that users search for information in a similar way to how animals search for food. Users adapt their search strategies to maximize information retrieval.

Key characteristics: users adjust their search strategies to find the most relevant information; emphasizes a balance between exploration (seeking new information) and use of known, relevant information; aims to, can be designed to help users find information more effectively by providing it in an accessible format.

5. Search results ranking algorithms

Modern search engines use a combination of methods, from classical statistical approaches to machine learning algorithms. One of the most effective is the BM 25 algorithm, which is based on a probabilistic interpretation of relevance (4):

$$skore(d,q) = \sum_i IDF(q_i) \frac{tf_i(k+1)}{tf_i + k\left(1 - b + b\left(\frac{|d|}{avgdl}\right)\right)}, \quad (4)$$

where *skore* (d, q) – the document relevance score d regarding the request q ; *IDF* (q_i) – inverse document frequency for a term q_i ; tf_i – - term frequency *and* in the document ; k – a parameter that controls the saturation of the frequency of a term (usually $k \in [1,2, 2,0]$; b – document length normalization parameter (usually $b \in [0,75, 1,0]$; $|d|$ – document length d (number of terms) ; *avgdl* – the average length of a document in the collection.

This model takes into account both term frequency and document length, which avoids over-estimation of large texts. Combined with semantic analysis and machine learning methods, BM 25 provides high search accuracy even in large data collections (see Fig. 3) [12].

An important tool for improving accuracy is the use of synonym dictionaries and thematic ontologies. Thanks to this, the search engine is able to take into account not only the literal match of terms, but also their semantic relationships. For example, in the field of e-commerce, a user may search for "smartphone", while in the database the product may be labeled as "mobile phone". If the system takes into account these synonymous relationships, it is able to provide a relevant result even in the absence of an exact match.

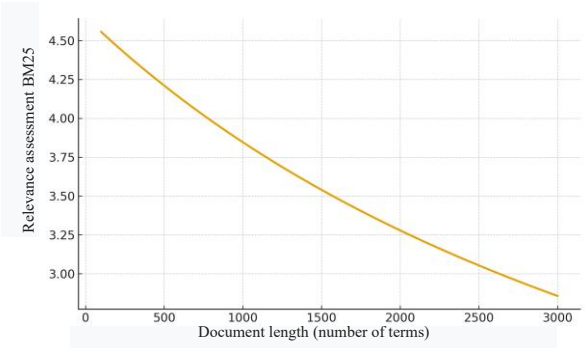

Fig. 3. Dependence of BM 25 relevance assessment on document length

Another direction is the expansion of queries, when additional terms are added to the initial search expression, which clarify or expand its meaning. This can be done both automatically and with the participation of the user. In modern systems, search personalization is becoming increasingly important, which takes into account the history of previous user actions, their interests and behavioral characteristics. This approach allows you to generate results that are as close as possible to the individual needs of a particular person [13].

For quantitative analysis of search quality, the metrics of precision (Precision) and recall are used. The first shows what proportion of the found documents is relevant, while the second reflects what proportion of all relevant documents the system was able to find. For a comprehensive assessment, the F-measure is often used, which combines both indicators into a single metric. In the scientific literature, other indicators are also found, such as the average precision (Mean Average Precision) or NDCG (Normalized Discounted Cumulative Gain), which allow for a more detailed assessment of the quality of the ranking of results (see Fig. 4) [14].

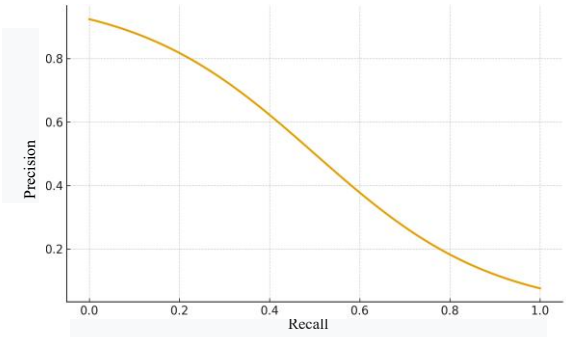

Fig. 4. The relationship between precision and recall for a search engine

6. Current trends in the development of search engines

The development of search engines is closely related to general trends in the field of information technology. If earlier the main attention was paid to the speed of search and optimization of indexes, today

semantic analysis and the use of artificial intelligence methods come to the fore. Modern systems strive not only to find documents containing the necessary words, but also to understand the content of the query, the context of its use and the user's intentions.

One of the key areas is the integration of natural language processing (NLP) methods. Thanks to this, search engines are able to take into account grammatical constructions, synonymy, word polysemy, and even emotional coloring of the text. In the field of e-commerce, this allows for more accurate recommendations for users searching for products using different wording.

An important trend is the use of machine learning methods and deep neural networks. They allow you to automatically detect hidden patterns in large data sets and build models that predict the relevance of results. For example, modern algorithms are able to take into account not only the text characteristics of a document, but also behavioral factors: click frequency, time spent on the page, purchase history. This makes the search more adaptive and personalized [15]. Another trend is the combination of search engines with recommendation engines. As a result, the user receives not only a list of documents that match his query, but also additional offers that may interest him. This approach is especially relevant for online stores, where search and recommendations become complementary elements [16 - 18].

7. Development of a search engine with relevance assessment

Based on the analysis, a search engine for an online store was developed with an assessment of search relevance. A full-fledged online store was implemented based on the WordPress [19] content management system using the WooCommerce plugin [20] and integrating the Advanced Woo Search search engine [21]. As a result, a holistic information and search system was created that meets the modern requirements of e-commerce.

The first step was to install and configure a local WampServer environment. This solution provided the ability to deploy the site in controlled conditions, allowed working with databases via phpMyAdmin, and provided flexibility in configuring PHP and MySQL parameters. The choice of WampServer was justified, as it combines ease of use with sufficient functionality for the implementation of the project.

The second stage was to create a website on WordPress. Due to its ease of installation and wide customization options, WordPress became the optimal platform for implementing an online store. The administrative panel was configured, basic pages were created, and a theme that supports WooCommerce was selected. This provided the foundation for further integration of e-commerce functionality.

WooCommerce integration turned the site into a full-fledged online store. The catalog, cart, and checkout pages were customized, products with different characteristics were added, categories and attributes were created. This allowed us to form a store structure that is understandable to users and meets e-commerce standards.

Special attention was paid to the implementation of the search system using the additional Advanced Woo Search. The standard WordPress search turned out to be insufficient for working with a large catalog of products, so the integration of an additional plugin became a key solution. Its advantage is the ability to configure the indexing of product fields, the application of weighting factors, flexible ranking and support for asynchronous results.

Advanced Woo Search provided search by name, description, categories and attributes, allowed to configure the weight of fields to determine the relevance of results and supports displaying results in real time. This allows you to implement a relevance search mechanism without creating your own search engine, while ensuring a high level of system adaptability, significantly increasing the usability of the site and making the search system more efficient.

Comprehensive testing of the developed information search system was conducted.

The first task of testing is to verify the basic functionality of the online store. To do this, several test products were created with different characteristics: simple products with a fixed price, variable products with variations, and products divided into categories. After adding products, the operation of the cart and checkout page was tested. The user had the opportunity to add several items to the cart, change their quantity, remove unnecessary products and proceed to checkout. On the order page, the system correctly displayed the total cost, took into account product variations and offered a choice of payment method. This confirmed that WooCommerce was functioning as expected.

Next, the search system was tested. A series of queries were performed, which included searching by product name, searching by category, and searching by attributes. For example, when entering the keyword "Granule", the system immediately displayed products with the corresponding name, as well as positions in which this word appeared in the description or category. When searching for the attribute "Shoes", the user received a list of products with the corresponding color. This confirmed the correctness of the indexing and relevance settings.

Special attention was paid to comparing the performance of Advanced Woo Search with the standard WordPress search. In the case of the basic search, the results were significantly limited, as the system only took into account the titles of pages and posts. Advanced Woo Search, on the other hand, provided a search by title, description, categories and attributes, which made the results more accurate and relevant. This confirms the feasibility of using an additional plugin in development.

Another important aspect of testing is the evaluation of system performance. The speed of displaying search results in real time was tested.

Even when entering long queries, the system worked without delays, which indicates the optimal settings. In addition, the site was tested when adding a

large number of products. Even with a significant load, the search engine remained stable, which confirms its scalability.

Thus, testing confirmed the operability of all system components.

Discussion of results

Testing of the search engine was conducted based on the metrics of accuracy (Precision), completeness (Recall) and relevance of the displayed results. Testing confirmed the operability of all system components. The online store processes orders correctly, and the search engine provides relevant results and high speed.

Comparison of standard WordPress search and Advanced Woo Search showed a significant advantage of the latter, which confirms the feasibility of its use in development. During the experiments, it was found that the use of a weight model and indexing of additional information fields allows to significantly improve the quality of the output, compared to standard WordPress and WooCommerce tools. The improvement is manifested in a reduction in the number of irrelevant results, faster finding of the necessary products and increased logical ranking. The improvement in the measured search efficiency indicators is 15–25 % depending on the complexity of the query.

Thus, the practical part of the study demonstrated the successful implementation of an information search system for an online store. It includes creating a local environment, deploying a site on WordPress, integrating WooCommerce, and configuring advanced search. The result meets the objectives and can be used as a basis for further development and improvement of the system.

Conclusions

As a result of the work performed, the set goal was achieved and a set of tasks aimed at developing an information search system for an online store with a mechanism for assessing the relevance of search results was implemented. Within the framework of the study, theoretical, analytical and practical stages were performed, which allowed creating an effective tool for increasing the accuracy and convenience of searching for goods.

In the course of the work, a detailed analysis of modern approaches to organizing search in e-commerce was conducted. The principles of information search systems, relevance assessment models (TF-IDF, BM25, probabilistic and vector models), as well as methods for increasing search accuracy, including text normalization, working with synonyms, weighting factors, and personalization of results, were considered. It was found that classic WordPress methods do not provide sufficient search quality in large product catalogs, since they do not take into account the weight of attributes, query morphology, and the context of user behavior.

Based on the analysis, the choice of the Advanced Woo Search plugin as the optimal tool for implementing improved search in an online store on the WordPress platform was justified.

In the practical part of the work, a full-fledged prototype of an online store with an improved search subsystem was developed and configured. Product fields were indexed (name, description, short description, categories, tags, attributes, article number), weighting factors were configured for various elements, mechanisms for ranking results and dynamic output when entering a query were implemented. The system is integrated with WooCommerce and fully supports processing queries of various structures and complexity.

Testing the functioning of the search engine showed a significant advantage Advanced Woo Search compared to standard WordPress and WooCommerce tools.

As a result, the work performed allowed us to create an effective information and search system that provides relevant ranking of results and significantly improves the user experience when interacting with the online store. The proposed solutions can be used to further expand the functionality of the store, integrate recommendation systems, connect semantic analysis or machine learning models. Recommendations are also formulated on possible areas of improvement, in particular, the implementation of semantic search, individualization of results based on behavioral data, and the use of external NLP modules to increase the accuracy of processing complex queries.

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МЕТОДИ ОЦІНКИ РЕЛЕВАНТНОСТІ ПОШУКУ В СИСТЕМАХ ЕЛЕКТРОННОЇ КОМЕРЦІЇ

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Анотація. Актуальність. В роботі розглянуто процес розробки інформаційно-пошукової системи для сучасних e-commerce рішень з оцінкою релевантності результатів пошуку. Класичні пошукові механізми, що ґрунтуються лише на збігу ключових слів, часто не враховують контекст та морфологію запитів, синоніми та вагомість окремих слів, ступінь відповідності знайдених результатів очікуванням користувача. Тому актуальним є створення інтелектуальної пошукової системи з оцінкою релевантності результатів пошуку, які здатні враховувати наміри користувача та адаптуватися до його індивідуальних потреб. Релевантність запиту має також непрямий вплив на інформаційну безпеку, особливо в контексті обробки даних додатками та системами, оскільки нерелевантні або аномальні запити можуть бути ознакою потенційних кібератак. Цей факт підвищує актуальність дослідження. **Предметом дослідження** у статті є методи підвищення релевантності результатів пошуку на основі аналізу запитів користувачів та ранжування характеристик товарів. **Метою статті** є підвищення ефективності пошуку у інформаційно-пошукових системах електронної комерції шляхом впровадження модифікованого методу оцінки релевантності. **Були отримані наступні результати.** Розглянуто вплив рівня релевантності запитів на рівень захисту інформації в інформаційно-пошукових системах, особливості формування пошукових потреб користувачів, аналіз моделей оцінки релевантності, розробка та тестування системи електронної комерції з оцінкою релевантності яка засвідчили покращення показників ефективності пошуку. **Висновок.** Використання методів оцінки релевантності для побудови пошукових систем у сфері електронної комерції є ефективним напрямом підвищення якості інформаційно-пошукових сервісів. Отримані результати свідчать про перспективність подальших досліджень у напрямі адаптації моделей інформаційного пошуку до специфіки онлайн-торгівлі, удосконалення алгоритмів ранжування та інтеграції методів машинного навчання для персоналізації видачі результатів.

Ключові слова: електронна комерція, пошукова система, релевантність, ранжування, ефективність пошуку, захист інформації, модель оцінки релевантності.