CHATBOT AND INTELLIGENT ASSISTANT:
BIBLIOMETRIC ANALYSIS AND RESEARCH IN BANKING SPHERE

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Today, the importance of chatbots and intelligent assistants is growing, given the rapid pace of information systems' development and the desire of consumers to receive advice at any time and on a self-service basis. Accordingly, the article presents the bibliometric and visual analysis of publications from the Scopus database in chatbots and intelligent assistants. According to the results obtained, the authors can note the following. First, the total number of publications in the scientific field of chatbots and intelligent assistants is on the rise, rapid development started in 2016, and the peak was in 2019. Second, chatbots and intelligent assistants' most relevant subject areas are computer science and engineering. However, chatbots and intelligent assistants get into other spheres (social sciences, decision sciences, medicine, etc.). It means that the research sphere becomes more interdisciplinary. Third, the highest publication activity demonstrates authors from the USA. Moreover, powerful publication clusters form around China, the Netherlands, Germany. Also, four authors from the USA are in the top 10 contributing authors in the research sphere. Fourth, 13 clusters form relationships between keywords within the research problem. The most significant clusters around the following keywords "intelligent assistants," "chatbots," "human-computer interaction," "artificial intelligence," "computer software". In addition, a comparative analysis of chatbots of three Ukrainian banks – PrivatBank, MonoBank, and Alfa-Bank, was conducted. This analysis identified the strengths and problem areas of each of the chatbots. According to the results of the investigation, PrivatBank and MonoBank chatbots are more competitive. Alfa-Bank chatbot has more "gaps," which reduce the effectiveness of interaction for users and need to be corrected. Thus, the research theme is in trend and will develop further. All findings of this paper and their graphical presentation are relevant. Scientists and practitioners can use them to understand the latest achievements and gaps in the "chatbot" and "intelligent assistant" fields and offer helpful guidance for further research.
Key words: chatbot, intelligent assistant, banking sphere, bibliometric analysis, visualization.

General problem statement. Communication with customers is essential for profitable and efficient business growth and development. Dialogue with the consumer can help the company understand the current market situation and forecast the future. In addition, consumers want more autonomy and self-service opportunities, preferring to make purchases or receive information without interacting with a live representative of the enterprise. Chatbots as unique channels of communication can help in it. With the help of chatbots, you can efficiently deliver any information (including advertising) by creating programmed dialogs.

Thus, the use of chatbots in business is gradually becoming a decisive factor in improving interaction. It transforms the experience of human-to-human interaction into the modern self-service experience and enhances the quality of customer service, indicating the topic's relevance.

Analysis of recent research and publications. The communications problem is up to time, and many scientists deal with it differently. The importance of communication for interaction with customers, including marketing communications, is highlighted in the following works [1–5]. The following results pay attention to internal communications as an effective tool for positive climate formation inside the enterprise [6–9].

The role of information technologies in communication network formation and increasing customer loyalty explain the subsequent papers [10–12].

The unresolved points of the general problem. However, the topic in scientific publications and practical implementation of "chatbot" and "intelligent assistant" in the banking sector remains insufficiently developed.

Formulation of the article's purposes. The main objectives of the article are an in-depth study of the relationship between the concepts of "chatbot" and "intelligent assistant" based on bibliometric analysis and a survey of existing chatbots in the banking sector.

Methodology and research methods. To achieve the purpose of the research, the authors carried a bibliometric analysis to define the main scientific directions in the sphere

of "chatbot" and "intelligent assistant" and define the gaps in existing scientific researches. The authors used the following articles as the basis of the bibliometric analysis [13–16]. Additionally, the authors provided a comparative examination of the chatbots of Ukrainian banks. The logical sequence of carried investigation is shown in Figure 1.

Presentation of the material. Considering all the limitations, 836 publications were selected for further consideration (data received in May 2021).

The distribution of scientific papers over the years is in Figure 2.

So, as we can see, the mention of chatbots and intelligent assistants began in 1983, but their popularity has grown since 2016. The reason is that times have changed, and the vast majority of people use smartphones, and chatbots have become widespread.

The authors who mainly worked on chatbots and intelligent assistants are mentioned in Table 1.

As can be seen from Table 1, all scientists have an h-index in Scopus Database higher than 5. The top four contributors of the research area are the following scientist: Brézillon, P., Augello, A., Gaglio, S., Pilato, G. Country of affiliation of three authors out of ten is Italy; four authors are from the USA; more two are from France, and one is from Mexico.

Also, it is essential to consider the geographical coverage of the publications in the research field (Figures 3, 4).
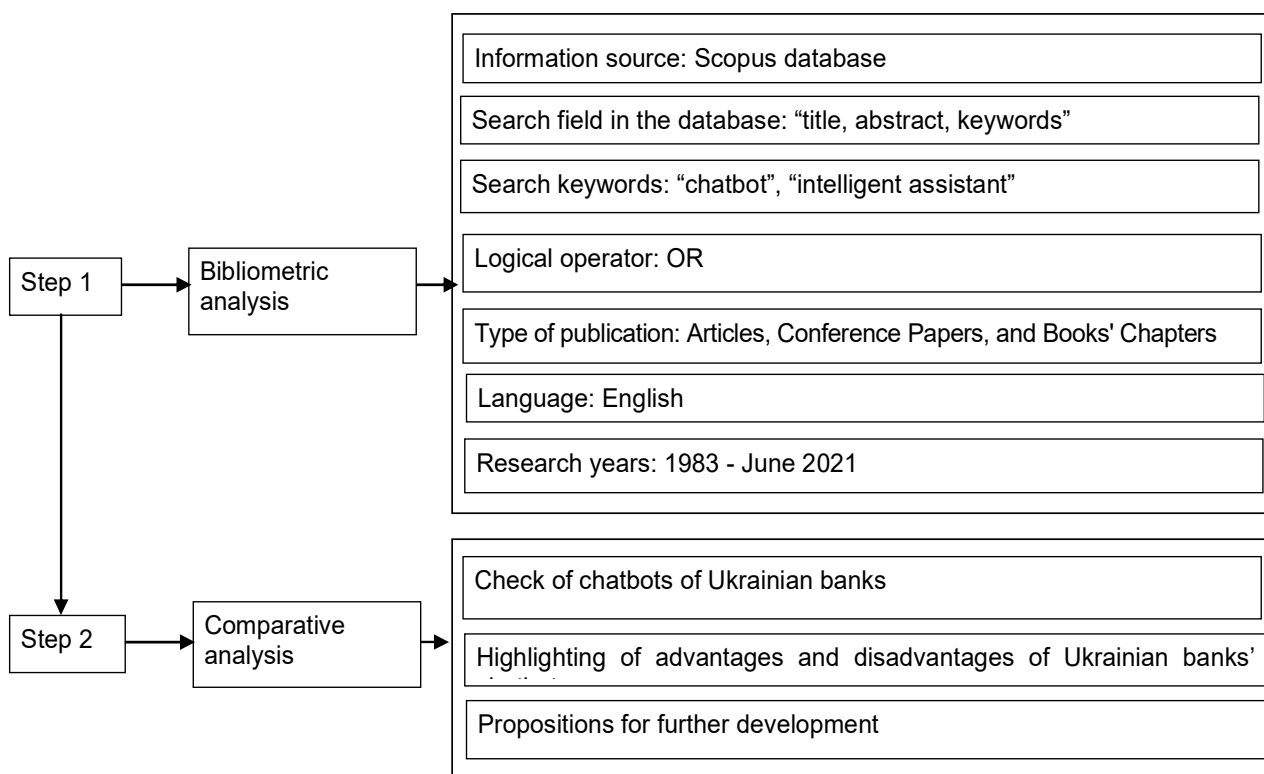
Figure 1. The steps of the authors' research

Table 1 – The number of published articles by the top 10 contributing authors

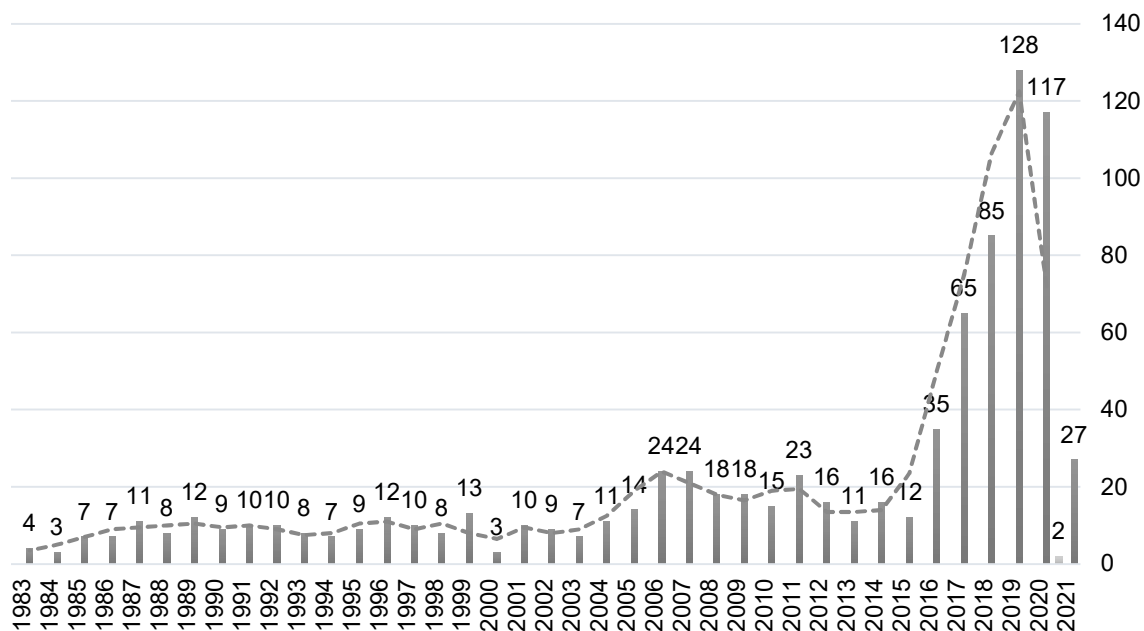| Author	Number of published articles	Country of affiliation	Author's h-index in Scopus Database
Brézillon, P.	10	France	22
Augello, A.	9	Italy	13
Gaglio, S.	9	Italy	22
Pilato, G.	9	Italy	17
Elizalde, F.	8	Mexico	5
Pomerol, J.C.	7	France	15
Zitouni, I.	7	USA	18
Fern, A.	6	USA	28
Natarajan, S.	6	USA	19
Tadepalli, P.	6	USA	22

Figure 2. Total number of publications in the research field from 1983 till May 2021 (based on Scopus Database)
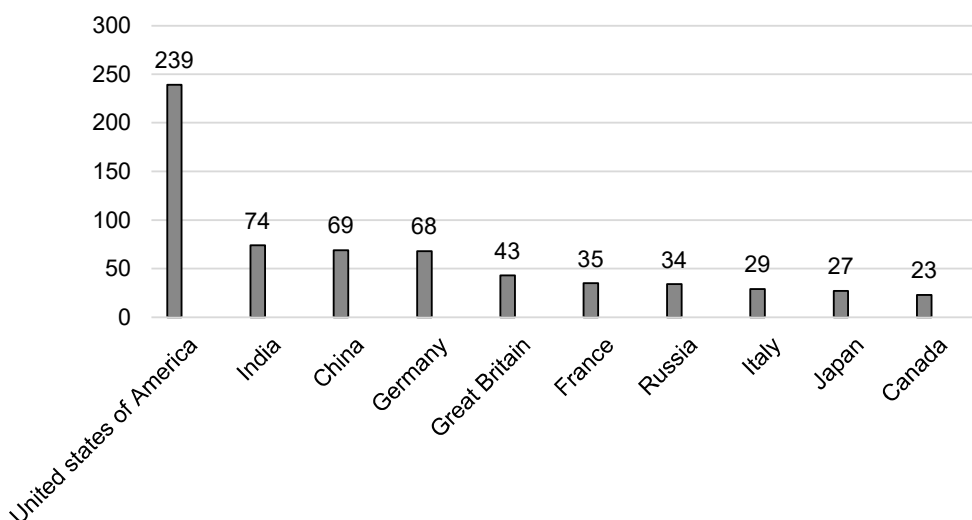

Figure 3. Countries with the most significant number of publications in the research field (based on Scopus Database)

After analyzing, we can conclude that most publications about chatbots and intelligent assistants have an affiliation to the following countries – the United States of America, India, China, and Germany.

Figure 5 shows a network illustrating the major publishing countries in chatbots and intelligent assistants.

As a result, the leading scientific cluster is formed around the USA, as technologies are always one step ahead.

Moreover, primarily chatbots and intelligent assistants are relevant to the following subject areas: Computer Science (41%), Engineering (20%), Mathematics (9%). It's reasonable as computer sciences made the essence of chatbots and intelligent assistants further development.

To identify the most frequent keywords relevant to the area, the network of relationships between keywords (co-occurrence) was formed using VOSviewer (Figure 6).

Thus, the generated network visualization between main keywords includes 13 clusters. Different clusters are illustrated in different colors. The same color of the nodes and keywords means that they belong to the same set. The most potent clusters form around the following key-words "intelligent assistants," "chatbots," "human-computer interaction," "artificial intelligence," "computer software."

Thus, a bibliometric analysis of the concepts of "chatbot" and "intelligent assistant" in the Scopus database helped determine the main scientific aspects and identify scientific
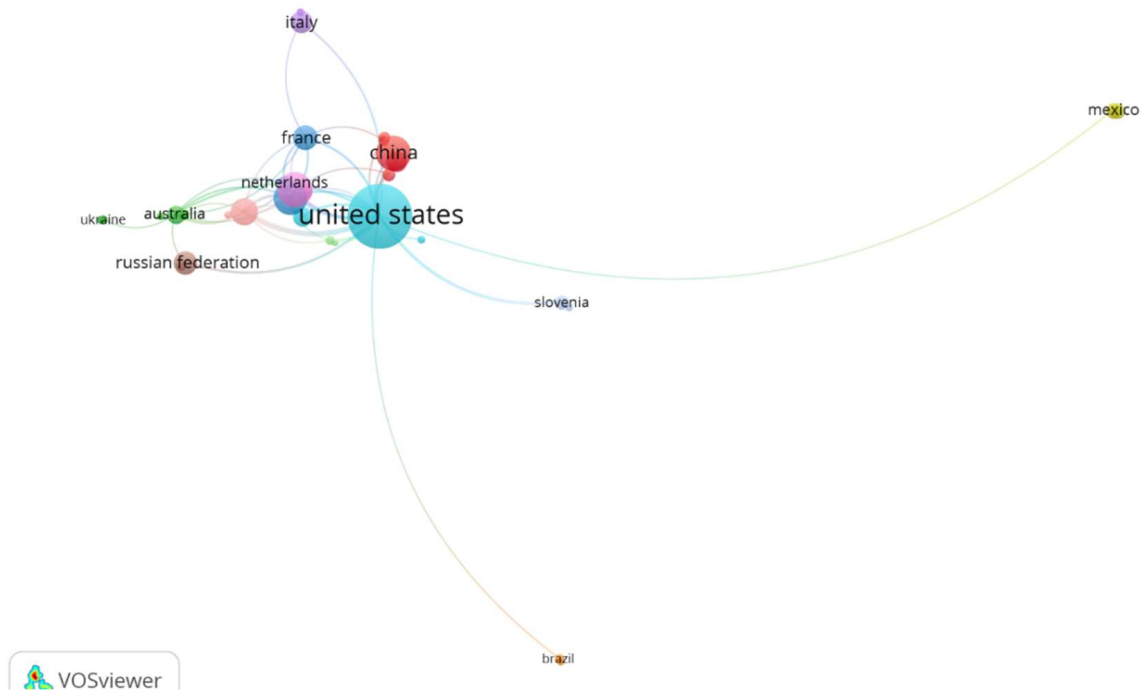
Figure 4. Clusters of countries with the most significant number of publications
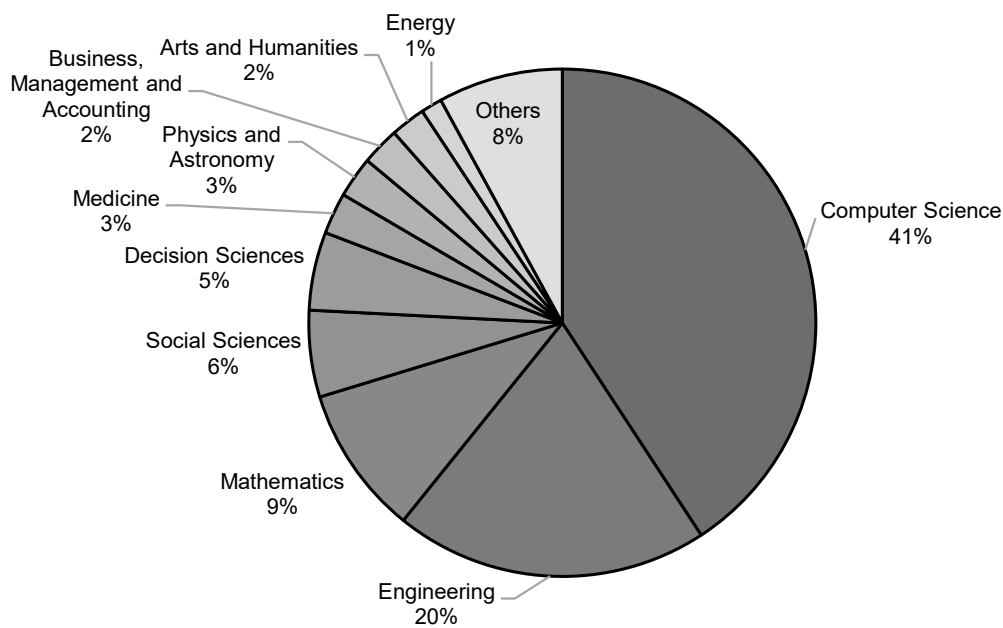

**Figure 5. The subject areas of the articles
in the sphere of chatbots and intelligent assistants**

gaps in this field. Bibliometric analysis shows that concepts of "chatbot" and "intelligent assistant" are becoming widespread and vital.

Also, we compared live communication with a consultant and communication with a chatbot (Table 2).

Thus, a chatbot, in general, can replace an online consultation. However, an advantage of live communication is more detailed answers to the most awkward questions. Therefore, for the high-quality operation of the enterprise, it is necessary to have operators.

Chatbots are widely used to help users, particularly in the banking sector. The bank's chatbots can help to get a loan or open deposits. We've analyzed the chatbots of three different banks in Ukraine: PrivatBank, MonoBank, and Alfa Bank. Specifically, we will review all their advantages and conclude which chatbot is more comfortable to work with (Table 3–5).

So, the strengths of a chatbot far outweigh the weaknesses. The main disadvantage is the difficulty of accessing online consultations.
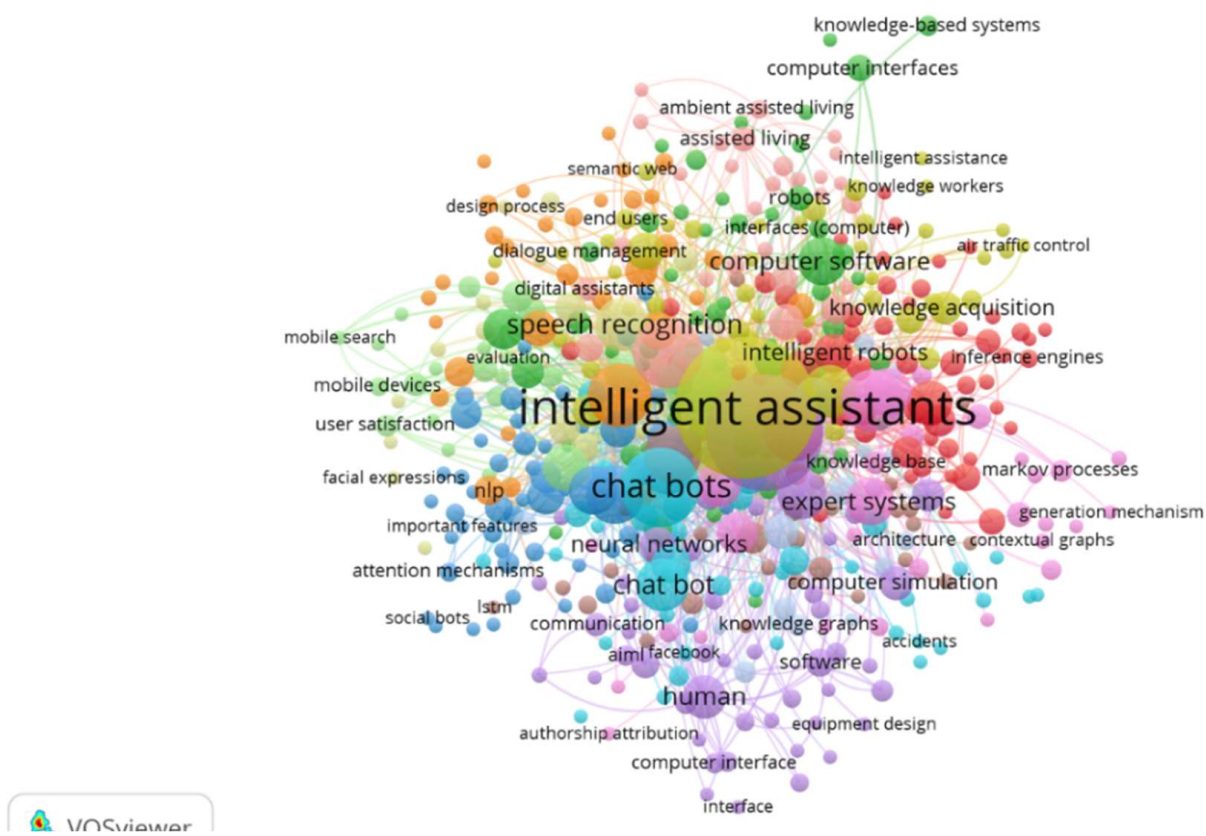
Figure 6. Network of relationships between keywords (based on Scopus Database), generated using VOSviewer

Table 2 – Advantages and disadvantages of consultant communication and chatbot communication

Advantages (+)	Disadvantages (-)
Information effective gathering	The complexity of implementation
Request processing speed	Ability to process only simple, non-complex requests
Service availability 24/7	The need for constant analysis and optimization of the system
Cost-effectiveness (no need to keep a staff of operators)	The cost of integration
The increasinglevel of customer satisfaction	Lack of creative approach to solving problems
No language barriers	Complications when working with "problem" clients
Lack of "human factor" (the state of health and mood of the operator do not affect the company's image)	Lack of emotions
Processing a large number of requests simultaneously	
The message is delivered instantly	

Table 3 – Advantages and disadvantages of PrivatBank chatbot

Advantages	Disadvantages
Clear information	Limited amount of tasks
Consultation in a language convenient for the client	Some features are not available quickly
Modern design with bank colors	There is no quick access to live chat with an online expert
Quick resolution of customer issues	
24/7 access to consultation	
Online communication with any customer-friendly messenger	

Table 4 – Advantages and disadvantages of MonoBank chatbot

Advantages	Disadvantages
Works in any messenger	It is not possible to ask own question, only choose from the provided
Language choice	Some answers are unclear
Stylish design	
Wide range of questions	
Quick switch to online consutant	
24/7 help	
Quick solution to the problem	

Table 5 – Advantages and disadvantages of Alfa Bank chatbot

Advantages	Disadvantages
Consultation in any language	Ability to communicate only through the bank application
Instant response to a request	Unfinished design
Works with any smartphone	A small range of questions
24/7 support	Not a very convenient menu
Quick access to an online consultant	

There are many advantages of this chatbot. It is a pleasure to work with it, and the problems are solved quickly. Chatbot updates are constant. With each updated application of MonoBank, new questions appear in the chatbot and their quick solution. The advantage is that MonoBank keeps tracking questions asked to online consultants. Some of these questions specialists add to the chatbot. More complex and essential questions are directed to the online consultation.

After the analysis, we can say that the advantages and disadvantages of this chatbot are equal, as the bank has just begun to use it. After the consultation with the chatbot, the user can evaluate it and leave a comment to improve the chatbot.

Conclusions. Thus, the results obtained based on bibliometric analysis confirm that the research sphere is becoming more interdisciplinary. The chatbot market has significant prospects due to its high performance and expected growth rate. Chatbots and intelligent assistants are currently an integral part of the digital strategy of most companies. Moreover, the work of a chatbot 24/7 dramatically simplifies life and saves time. All mentioned above indicates the feasibility of chatbots and intelligent assistants' implementation in various fields.

Further research will focus on finding ways to use chatbots in education.

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ЧАТ-БОТ ТА ІНТЕЛЕКТУАЛЬНИЙ ПОМІЧНИК: БІБЛІОМЕТРИЧНИЙ АНАЛІЗ ТА ДОСЛІДЖЕННЯ ВИКОРИСТАННЯ У БАНКІВСЬКІЙ СФЕРІ

Сьогодні важливість чат-ботів та інтелектуальних асистентів зростає, ураховуючи швидкі темпи розвитку інформаційних систем та бажання споживачів отримувати консультацію у будь-який час на основі самообслуговування. Відповідно до цього, у статті представлено результати проведеного бібліометричного та візуалізаційного аналізу публікацій із наукометричної бази даних Scopus у сфері чат-ботів та інтелектуальних асистентів. Відповідно до отриманих результатів, можна відзначити таке. По-перше, загальна кількість публікацій у досліджуваній сфері чат-ботів та інтелектуальних помічників зростає. Стрімкий розвиток почався у 2016 р., а пік припав на 2019 р. По-друге, проблематика чат-ботів та інтелектуальних помічників є найбільш розробленою у галузі інформатики та інженерії. Однак сфера дослідження чат-ботів та розумних помічників постійно розширюється та вже охоплює соціальні науки, науки про прийняття рішень, медицину та ін. Це означає, що сфера досліджень стає більш міждисциплінарною. По-третє, найвищу публікаційну активність демонструють вчені зі Сполучених Штатів Америки. Потужні публікаційні кластери формуються навколо Китаю, Нідерландів, Німеччини. Окрім того, чотири автори зі США входять до 10 найкращих авторів у дослідницькій сфері. По-четверте, 13 кластерів формують зв'язки між ключовими словами в рамках досліджуваної проблеми. Найбільш значущі групи утворилися навколо таких ключових слів, як «інтелектуальні помічники», «чат-боти», «взаємодія людина-комп'ютер», «штучний інтелект», «комп'ютерне програмне забезпечення». Проведено порівняльний аналіз чат-ботів, які використовуються трьома українськими банками: PrivatBank, MonoBank та Alfa Bank. Цей аналіз дав змогу визначити сильні боки та проблемні зони кожного з чат-ботів. Відповідного до результатів аналізу, більш конкурентоспроможними є чат-боти PrivatBank та MonoBank, чат-бот Alfa Bank має більше «прогалин», які знижують ефективність взаємодії для користувачів та мають бути виправлені. Таким чином, висновки цієї роботи та їх графічне представлення є актуальними. Науковці та практики можуть використовувати їх, щоб зрозуміти останні досягнення та прогалини в галузях «чат-бота» та «інтелектуального помічника».

Ключові слова: *чат-бот, інтелектуальний асистент, банківська сфера, бібліометричний аналіз, візуалізація.*