RESEARCH ARTICLE

Exploring Public Response to ChatGPT With Sentiment Analysis and Knowledge Mapping

JINQIAO ZHOU[1], ZIQI LIANG[2], YUHUA FANG[3], AND ZHANXI ZHOU[4]

[1]College of Art, Zhejiang Normal University, Jinhua 321000, China
[2]School of Arts and Media, Guangzhou Vocational and Technical University of Science and Technology, Guangzhou 510000, China
[3]Faulty of Social Science and Humanities, Universiti Teknologi Malaysia, Johor Bahru 81310, Malaysia
[4]College of Engineering, Northern Arizona University, Flagstaff, AZ 86011, USA

Corresponding author: Jinqiao Zhou (zhoujinqiao@zjnu.edu.cn)

ABSTRACT Information about artificial intelligence generated content (AIGC) has attracted great attention from the public. ChatGPT has gained attention from many countries due to its powerful functionality and efficiency. However, there are still many countries, such as China, that refuse to introduce ChatGPT into their own countries. This article aims to study the attention that ChatGPT has attracted in China, further investigate the reasons for the obstruction of ChatGPT's dissemination, and provide prospects and suggestions for the global development of artificial intelligence. First, we apply the Latent Dirichlet Allocation (LDA) topic modeling algorithm to analyze the 28,122 web tweets and comments from China regarding ChatGPT. The results show that there are more negative emotions compared to positive and neutral emotions. The attention on ChatGPT rapidly increased twice between March and May 2023. We find the audience interest and concern words: "improvement", "company" and "technology". The analysis reveals three main themes: social, technological, and educational. Additionally, we conduct knowledge mapping to analyze the publication time, research hotspots, and subject distribution of Chinese scholars' literature. In conclusion, this paper highlights several key issues that need to be addressed for the further advancement of AIGC, including the evolution of job roles, the changing technological landscape, the pursuit of artificial general intelligence, and ethical concerns.

INDEX TERMS LDA modeling, artificial intelligence, sentiment analysis, ChatGPT.

I. INTRODUCTION

In recent years, AIGC has garnered significant attention beyond the computer science community. AIGC refers to content that is generated using advanced generative AI (GAI) technology instead of being created by human authors. The development of AIGC has overcome the previous limitations in content generation quantity and scale, leading to automated and intelligent content generation. Consequently, there is a growing interest in various content generation products offered by major tech companies [1], such as artificial

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intelligence (AI) chatbots. A chatbot is a typical example of an AI system and one of the most elementary and widespread examples of intelligent Human-Computer Interaction (HCI) [2]. Chatbots are useful in applications such as education, information retrieval, business, and e-commerce [3].

ChatGPT, an artificial intelligence chatbot developed by OpenAI, represents the latest development in the domain of chatbots. Currently, discussions surrounding ChatGPT intelligence span over 30 disciplines, primarily encompassing education, publishing, law, governance, economics, intelligence, tool value, national security, and personal cognition. For instance, in relation to education, some scholars, such as Rospigliosi [4], examine the relationship between artificial

intelligence and learning. Hwang and Chang [5] advocate for innovative teaching methods and enhanced learning processes through empirical research on effective learning designs involving chatbots. ChatGPT also holds substantial political and social significance. Ahn and Chen [6] highlight how countries have recognized the importance of artificial intelligence in building digital governments, particularly in terms of optimizing government operations and capitalizing on new product values in Chinese economy. Guleria et al. [7] delve into the practicality and versatility of ChatGPT for court investigations and address the ethical and legal concerns surrounding its usage. Furthermore, Xu et al. [8] provide an in-depth exploration of chatbot applications in the medical field, including cancer diagnosis, screening, treatment, patient monitoring, support, and management. It is easy to see that artificial intelligence can help the development of human society.

Despite the identified beneficial use cases for chatbots in these examples, some clear limitations remain. For example, AI chatbots may enhance human laziness. The future iterations of ChatGPT-like AI could become significant factors in social development, introducing unforeseen risks to public security. AI chatbots may become tools for stealing secrets between countries. Furthermore, the current development of artificial intelligence is far from enough to help humans completely improve their work and life. It follows from [9] that more than 89% of students utilize ChatGPT for homework assignments, while 48% rely on it for quizzes and 53% for essay writing. According to Professor Antony Aumann, a philosophy professor, the "best paper in the class" written by students who utilized ChatGPT [10]. In China, Prof. Qian, the dean of the School of Economics and Management at Tsinghua University, is among the most prominent voices, arguing that ChatGPT has eroded the advantages of traditional Chinese education [11]. We can also find a large number of posts online about ChatGPT leaking information. Due to various concerns, several districts and schools have imposed complete bans or restrictions on ChatGPT.

Therefore, we take the currently popular ChatGPT as the object to conduct in-depth research on the development direction of artificial intelligence. This paper aims to study the attention that ChatGPT has received in China. First, we apply the Latent Dirichlet Allocation (LDA) topic modeling algorithm to analyze the 28,122 web tweets and comments from China regarding ChatGPT. This process can help us understand the emotional attitudes of the Chinese people towards ChatGPT. Furthermore, we conduct knowledge mapping to analyze the publication time, research hotspots, and subject distribution of Chinese scholars' literature. This paper applies data mining and knowledge mapping to analyze the public sentiment and academic analysis related to ChatGPT in China. This paper contributes to the enrichment and expansion of research in the field of user information behavior and provides essential insights for the development and adaptation of ChatGPT.

II. THEORY AND METHODS

Sentiment analysis [12], [13], [14], also known as opinion mining [15], [16], is a text analysis technique used to detect sentiment within text. It is a research area that aims to understand what others think or care about. Mass opinion plays a crucial role in decision making, whether it's an individual choosing a travel destination or a company revisiting a product design. In recent years, there has been significant research in challenging areas like deep learning architectures for sentiment analysis. Mohammad focused on sentiment analysis of coronavirus-related tweets from eight countries using deep learning techniques [17]. Usama proposed a model based on Recurrent Neural Networks (RNN) with CNN-based attention mechanisms [18]. Ghasemi proposed a cross-lingual deep learning framework to address the problem of sentiment analysis in low resource languages, specifically in the Persian language [19]. Divate proposed sentiment analysis of Marathi e-news to assist online readers [20]. The field of sentiment analysis has gained popularity due to its wide range of applications, leading to the emergence of a multimodal dimension. This extends sentiment analysis to other modalities [20], [21], [22]. Sentiment identification is a very complex problem, and thus much effort has been put into analyzing and trying to understand its different aspects. One can refer to [23], [24], [25], [26], [27], and [28].

The adaptation of Latent Dirichlet Allocation (LDA) for short texts is a prominent area of research. The LDA model [29] posits that each word in a document probabilistically selects a topic and subsequently selects a phrase from that topic. By effectively modeling text, the LDA model enhances the information obtained through the traditional spatial vector model by integrating probabilities. Through the application of the LDA topic model, we can identify latent topics within the data and subsequently analyze the focal points of the dataset along with their corresponding distinguishing words. The LDA model is capable of capturing the multitopic characteristics of documents [30], and it is the simplest topic model that is suited for analyzing text documents [31]. Many scholars use the LDA model for sentiment analysis. For example, Ozyurt and Akcayol [32] introduced a novel method for aspect-based sentiment analysis called Sentence Segment LDA (SS-LDA). Li et al. [33] utilized data visualization and an LDA theme analysis model to crawl specific information and reviews of popular movies, enabling the determination of movie trends and audience preferences. More articles refer to [34], [35], [36], [37], [38], and [39].

Bibliography is an important branch and specialized research method within information science and philology. It plays a crucial role in scientific communication and the development of basic theories, and is increasingly recognized as a core area [40]. The essence of bibliometrics is to analyze the research object as a whole using quantitative methods, facilitating scientific literature management and advancing the development of the field. This approach has broad applications, including core journal identification, assessment of literature utilization rates, and evaluation of publications.

The VOSviewer software has a multitude of applications in the field of bibliometrics. Van Eck and Waltman [41] demonstrated the utilization of VOSviewer for clustering publications and analyzing the resultant clusters. Yu et al. [42] utilized VOSviewer to conduct bibliometric analysis on keywords like "COVID-19". Ding and Yang [43] provide a systematic review of academic research on platforms in management, business, and economics. Nandiyanto et al. [44] employed VOSviewer to extract search results and analyze them further for bibliometric mapping. McAllister et al. [45] applied VOSviewer to explore the relationships among publications authored by university faculty in engineering.

III. RESEARCH DESIGN
A. RESEARCH DESIGN BASED ON SENTIMENT ANALYSIS
1) RESEARCH FRAMEWORK
Firstly, the comment data from Weibo Super Talk and Bili Bili platform are crawled using Python's requests module. Secondly, the data undergoes preprocessing, including manual cleaning, deactivation, and word splitting. The thesaurus is then streamlined and de-defined using the Knowledge Network Sentiment Dictionary as the benchmark. Simultaneously, the lexical properties of emotion words are redefined using SO-PMI to obtain the domain emotion thesaurus, and scoring rules are devised for determining the emotional tendency of the text. To delve deeper into the connotation of the text, feature words and corresponding word frequency vectors are obtained through TF-IDF feature extraction of the comments. Themes are identified and the emotional tendencies of each theme are determined using LDA for theme mining. Finally, research conclusions and insights are drawn by analyzing the themes and emotional tendencies in the comments (FIGURE 1).
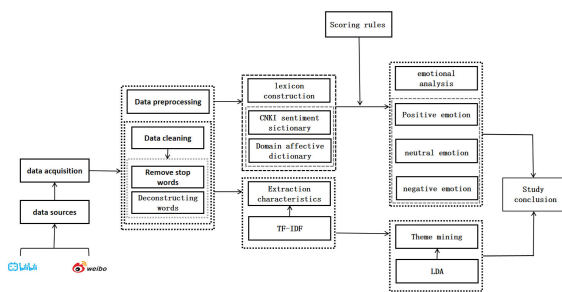

FIGURE 1. Graphical representation of LDA.

2) RESEARCH PLATFORMS
Two platforms, Weibo and Bilibili, were selected as data sources for analyzing user comments in China to obtain comprehensive data. Microblogging is a broadcasting social media and network platform that facilitates the sharing, dissemination, and acquisition of user relationship information through mechanisms such as following and sharing short real-time information. According to the financial report released by Sina Weibo, the monthly active users of Weibo in

March 2023 were 5.93 billion, and the average daily active users in March 2023 were 2.55 billion. Bilibili, also known as "B Station", is a popular cultural community and video platform among the younger generation in China. According to Alexa, a third-party web traffic statistics organization, as of October 2023, B Station ranked fourth globally and second in China, with an average daily unique visitor count of 218 million and an average daily page view count of 2.31 billion. Thus, utilizing these platforms as data sources is highly persuasive and scientifically grounded.

3) RESEARCH METHODOLOGY
Topic mining, also known as topic extraction, involves mapping high-dimensional evaluated text content to a low-dimensional semantic space. In this paper, we utilize the Latent Dirichlet Allocation (LDA) topic model for characterizing the content topics of ChatGPT. LDA is an unsupervised machine learning technique that employs a three-layer Bayesian probabilistic model to uncover latent topic information within large-scale documents. The generation process of "document-word items" within a document can be described as follows (see FIGURE 2). LDA model results are derived from two probability distributions: document-topic and topic-word. The document-topic probability distribution represents the support weight of each topic in the document, where a higher weight indicates greater relevance between the document and the topic. The topic-word probability distribution reflects the internal structure of each topic, and a higher probability of a feature word signifies a greater contribution of that word to the topic [46].
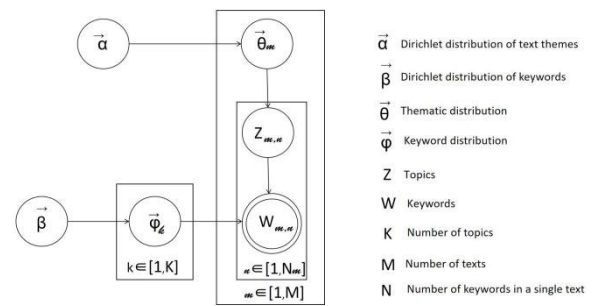

FIGURE 2. LDA topic generation process model.

Segmentation is the cutting of microblog text into individual words according to Chinese grammar rules. In the process of element selection, different word-splitting effects directly affect the sentiment scores of the words, thus influencing the results of data analysis [47]. The textual data of Weibo and BilBli are characterized by short textual content, high degree of colloquialism, uncritical language structure, and commonly used network text, which makes the sentiment analysis method different from traditional textual sentiment analysis [48]. In addition, more complex forms of Chinese expressions increase the difficulty of performing sentiment analysis on microblog data.

In this study, we employ the JIEBA word segmentation method, which is an open-source approach known for its ease of installation and high accuracy. It is particularly suitable for analyzing large volumes of text and is widely adopted by non-computer professionals [49]. JIEBA word segmentation analysis offers three modes, and the exact modal word segmentation mode efficiently segments discourse without overlapping words, thereby addressing the issue of ambiguity to a significant extent. Consequently, we select the exact mode of JIEBA word segmentation in this study and invoke the cut method to perform text segmentation on the comment data.

Pointwise Mutual Information (PMI) is a valuable measure employed in natural language processing to evaluate the correlation between two words. This correlation is determined by calculating both the probability of their simultaneous occurrence and the probability of each word occurring individually.

Word cloud analysis is a visualization technique used for the statistical analysis of word frequency and the graphical representation of high-frequency words in a given text. It serves to effectively filter out irrelevant information, highlight the distinctions among keywords, and visually present significant information within the text [51]. In a word cloud, different colors are used to represent the word clouds of various keywords, while the font size of words corresponds to their frequency of occurrence. Consequently, keywords with higher frequencies are displayed more prominently in the word cloud, indicating their greater weight and ability to represent the thematic tendencies of the text [52]. Popular word cloud analysis tools encompass visual programming tools based on Python, as well as Jasondavies, which supports English texts, and WordCloud, an online tool specifically designed for Chinese texts.

B. RESEARCH DESIGN BASED ON KNOWLEDGE MAPPING

Research related to ChatGPT is experiencing rapid development, with overall results showing significant growth. China stands out as the country with the largest research output globally, while the United States remains the leading research authority. Chinese universities exhibit a substantial advantage in terms of scientific research output. Despite China's significantly higher publication volume, which is four times that of the United States, its total citation count is less than one-third of the United States' count. Moreover, research achievements from the United States receive citation frequencies that are as high as 7.5 times greater than those of China. This article employs knowledge graph collinearity and network data sentiment analysis to provide a precise and comprehensive study of China's research direction on ChatGPT. The aim is to offer scholars suitable and valuable topics for selecting artificial intelligence tools in their own research endeavors. This study concentrates on the topic of "ChatGPT" and the literature is sourced from the CNKI Chinese Academic Journal Network, which encompasses core publications, conference papers, and more. The retrieval

period spans from December 2022 to September 1, 2023. Systematic thematic reading was conducted to identify and acquire pertinent literature. In this study, the VOSviewer tool was employed to assess the collinearity of keywords associated with ChatGPT. Additionally, the tool was complemented with secondary literature analysis to explore current hot topics and evolving trends within the field. Moreover, the study aimed to provide insights into future research directions.

IV. EMPIRICAL RESEARCH BASED ON SENTIMENT ANALYSIS AND THEME MINING

A. COLLECTION AND PROCESSING

Data collection and data preprocessing: Throughout the entire data collection process, the author conducted multiple screenings on the data. Before crawling data, the author examines and manually filters the data to be crawled based on the topic, ensuring that the data to be crawled meets the requirements of the topic. During the crawling process, the author crawls in batches and checks the data to reduce errors. A Python-based crawler program was utilized to collect a cumulative total of 30,501 comment data from B station and Weibo. The data were collected on August 15, 2023, and included user ID, city, gender, comment content, and comment time. We provide some typical examples with obvious emotional characteristics in Table 1. After obtaining preliminary data, the crawled data primarily consisted of unstructured and irregular content, proper preprocessing was necessary to ensure data integrity and accuracy. This involved manual removal of empty values, duplicate data, advertisements, and other irrelevant information. Subsequently, we obtained a set of 28,122 valid data points. To ensure accuracy and effectiveness in subsequent data analysis, further steps were taken. Firstly, the duplicate evaluations and short texts containing less than 5 words were eliminated using the duplicate item marking function and string function in Excel software. Secondly, through programmatic algorithms, the Jieba word segmentation tool was applied for document word separation and the exclusion of English alphabets, numbers, meaningless words, and other irrelevant content. Ultimately, a vocational education online fine course evaluation corpus consisting of 28,122 keyword texts was constructed.

B. CONSTRUCTION OF EMOTION DICTIONARY

The Knowledge Network Emotion Dictionary, consisting of six folders ("Positive Emotion," "Negative Emotion," "Positive Evaluation," "Negative Evaluation," "Degree Level," and "Claim"), contains a total of 17,877 words. However, to enhance word selection accuracy and applicability, uncommon words were initially removed. Regular expressions were then employed to match the content of the comments with the Knowledge Sentiment Dictionary (excluding "Degree Level" and "Claim"), resulting in the retention of sentiment words appearing in the comments, yielding a total of 1,833 words.

TABLE 1. Selected comment data.

User Name	Timing	Municipalities	Genders	Commentaries
kelly_lyinginthesun	2023-04-30 15:39:55	BeiJin	female	ChatGPT, you are my god！
HowieX-	2023-05-12 19:10:54	ZheJiang	male	Hahaha! chatGPT is really awesome!
East, West,South And North	2023-04-30 12:31:58	ShanDong	female	I think chatGPT is an epoch-making invention.
Burn the midnight oil	2023-04-12 23:09:34	JiangXi	female	chatGPT is simply great!
Reverse41047	2023-05-18 22:42:38	BeiJin	male	ChatGPT is so good!

From these 1,833 words, 20 positive emotion words (such as ''good-looking,'' ''full marks,'' ''wonderful'') and 20 negative emotion words (such as ''hard,'' ''harsh,'' ''bad'') with word frequencies exceeding 100 were selected. The benchmark words, including ''hard,'' ''disappointment,'' and ''regret,'' were employed to utilize SO-PMI (Semantic Orientation-Pointwise Mutual Information) to calculate the pointwise interaction information between the 1,833 emotion words and each benchmark word. The resulting SO-PMI values were utilized to classify the sentiment polarity of the emotion words, thereby constructing a domain-specific sentiment lexicon.

C. DETERMINATION OF SCORING RULES

The following scoring rules are formulated based on the results of word segmentation, the Knowledge Sentiment Dictionary (including a degree adverb dictionary), and the Domain Sentiment Dictionary. Firstly, the comment data undergo preprocessing, which includes subwording and the removal of deactivated words, among other steps. Next, a Python program is employed to utilize the human domain sentiment dictionary, determining the polarity of each word. Positive sentiment words are assigned a score of $+1$, while negative sentiment words receive a score of -1. The program also checks whether a degree adverb precedes the sentiment word in question. If present, the score is multiplied by the weight assigned to the degree adverb. Conversely, if no degree adverb is found, no scoring modification is made. Additionally, the procedure is repeated to identify if a negative word appears before the word being evaluated. This process continues until the traversal of comments is completed, resulting in the final score.

D. FINDINGS OF THE STUDY
1) TIME ANALYSIS

The number of user comments discussing ChatGPT fluctuated greatly between January and August 2023. Notably, there

were significant fluctuations in March and April 2023, with peak activity occurring during those months. In particular, the number of comments in April 2023 surpassed 3000, representing the highest peak of activity (FIGURE 3). Between May and August 2023, the number of comments exhibited a degree of elasticity and remained relatively stable, ranging from 0 to 500. The heat of ChatGPT erupted rapidly twice between March and May 2023. But after that, its heat remained stable without significant improvement. Looking back at the development history of ChatGPT, we noticed that in March 2023, OpenAI released GPT-4 and announced the launch of plugin functionality, giving ChatGPT the ability to use tools, connect to the internet, and run computing [53]. At this time, the public is full of surprises, delight, etc. However, at the same time, a bug in ChatGPT resulted in some users being able to see the conversation titles of other users [54]. The bug revealed information such as the user's name, email address, payment address, last four digits of the credit card number, and expiration date of the credit card. At this time, the public is full of anxiety, fear, etc This indicates the public's expectations for the development of artificial intelligence and concerns about information leakage [55], [56].
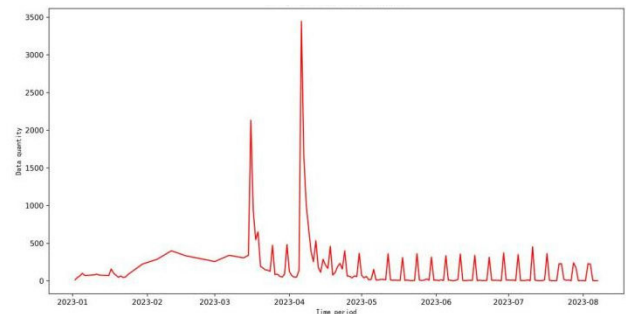
FIGURE 3. Diagram of the timing of discussions on ChatGPT.

2) OVERALL ANALYSIS OF SENTIMENT INDEX

The overall sentiment index is derived from the sentiment tendencies of user comments (see Table 2). It reveals that there were 11,398 positive sentiments, accounting for 40.53% of the total; 999 neutral sentiments, comprising 3.55%; and 15725 negative sentiments, making up a mere 55.92%. Overall, positive emotional evaluations exceed negative emotional evaluations, but the difference is not significant, with a ratio of approximately 1.38:1. This indicates that the audience has a more negative attitude towards ChatGPT than a positive attitude. This may also be the reason why China restricts the use of ChatGPT.

3) ATTENTION HOT SPOT ANALYSIS

The size of the words in the word cloud map indicates the frequency of keywords, with larger font sizes representing higher overall frequencies of occurrence. This signifies the main hotspot capturing the audience's attention. In this

TABLE 2. Overall evaluation of the sentiment index of user comments.

Emotional classification	Quantity	Percentage（%）
Positive emotion	11398	40.53%
Neutral emotion	999	3.55%
Negative emotion	15725	55.92%
Total	28122	100%

paper, the utilization of customized dictionaries for word segmentation proves to be more effective. It allows the segmentation of words like "Improvment", "Company", "human", etc., as depicted in FIGURE 4 and FIGURE 5 The occurrence of negative emotion words like "Nonsense", "Anxiety", etc. in FIGURE 4 demonstrates a high frequency. This indicates that the audience's attitude towards ChatGPT is mostly concerned and suspicious, rather than blindly fearful. Moreover, it is not difficult to detect the existence of "satisfied", "Delighted" and "Great", which suggests that the audience are satisfied and delighted with the use of ChatGPT. Additionally, the keyword word cloud graph in FIGURE 5 highlights a higher frequency of the terms "improvement", "company", "technology", "development" and "industry". These represent the main areas of audience interest and concern. These indicate that the development of the technology industry is closely related to artificial intelligence and is a major focus of public attention.
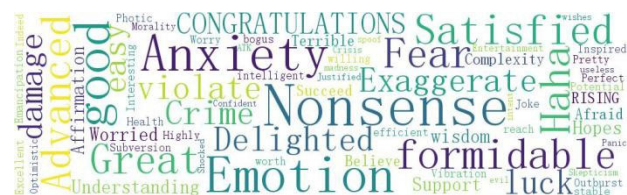

FIGURE 4. Emotional word cloud map.

FIGURE 5. Keyword word cloud map.

4) REGIONAL ANALYSIS
From a regional analysis perspective in China, cities such as Guangdong, Beijing, Zhejiang, Shanghai, and Jiangsu exhibit a high level of engagement with ChatGPT discussions (Refer to Table 3). Notably, the southern and coastal areas of China have witnessed extensive discussions. Guangdong Province, situated south of the South China Sea and in close proximity to the renowned financial center of Hong Kong and the international metropolis of Macau, plays a pivotal

role. Moreover, as a pioneering technology province in China, ChatGPT's discussions are particularly prominent. Beijing, China,follows Guangdong as the second region of interest in ChatGPT discussions. Beijing serves as China's political center, international communication hub, and technological innovation center. This highlights that the regions exhibiting the highest interest in ChatGPT discussions in China are those with advanced levels of economic and scientific-technological development.

TABLE 3. Discussion level of ChatGPT in each province.

Discussion level	Province
More than 3500 people	Guangdong
3000-3499 people	\
2500-2999 people	\
2000-2499 people	Beijing
1500-1999 people	Shanghai, Jiangsu, Zhejiang, Sichuan
1000-1499 people	Shandong
Less than 999 people	Others

5) TOPIC SENTIMENT ANALYSIS
In order to delve into the textual content and overcome the limitations of accurately locating theme levels through word cloud maps, a deeper level of theme mining is conducted using the Python sklearn library with LDA (Latent Dirichlet Allocation). The specific approach is as follows: the comments, after word segmentation, undergo feature extraction via the feature_extraction class in sklearn, resulting in feature words and word frequency vectors. Next, the model is generated using LDA in decomposition, with the iteration number set to 100 and online training employed. Through multiple parameter adjustments, the pyLDAvis visualization effect graph is compared and observed to determine the optimal number of topics. Repeated experiments confirm that the most favorable outcome is achieved when the value of K is set to 3 (FIGURE 6).

The three bubbles on the left side are clearly not intersecting, indicating a strong thematic cohesion. When the left bubble is clicked, the right side displays the top 30 key feature words within the topic. The frequency of the word in the entire document is represented by a light gray color, while the weight of the word in the topic is indicated by a dark red color (see FIGURE 6). For example, in Topic 1, the words "Artificial Intelligence", "Company", "Model", "Technology", "Tech", "Release" and "China" are prominently featured. These words, along with "Data", "Robots", "Users" and "Products" collectively summarize the impact of ChatGPT on the development of human technology. Topic 2 focuses on human society, encompassing concepts such as "World", "Replace", "Live", "Work", "Consciousness", "Develop", "Create", "Change", "Think", "Unemployment", "Productivity", "Impact", "Career", and "Invention". This topic explores thoughts regarding human society. Finally, Topic 3 delves into the impact on education, encompassing aspects such

as "Students", "Essay", "Language", "Code", "Video", "Answer", "Teacher", "Input", "Text", "Homework", "University", "Content" and "translation". Please refer to Table 4 for further details.

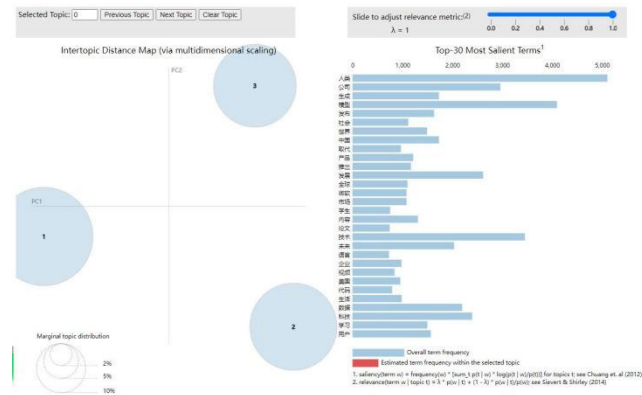**FIGURE 6.** Visualization of user review topic mining.

TABLE 4. ChatGPT user evaluation theme mining table.

Topic	Feature word
（Topic 1) Technological impact	Artificial Intelligence,Company, Model, Technology, Tech, Number, Robot, User, Product, Industry, Microsoft, Enterprise, China, US, Chip, Digital, Huawei, Field, Market, Arithmetic, Chat, Future.
（Topic 2) Social impact	Human society, World, Replace, Life, Job, Consciousness, Development, Creation, Change, Thinking, Unemployment, Productivity, Influence, Occupation, Invention, Industrial. revolution, Job, Change, Obsolescence, Meaning, Life, Earth.
（Topic 3) Educational development	Student, Essay, Language, Code, Video, Answer, Teacher, Input, Text, Homework, University, Content, Translation, Math, Course, Question, Writing, Output, Copy writing, English, Method, Creation, Professor, Training, Tool.

To gain a comprehensive understanding of the impact of audience feedback on each topic, it is essential to analyze both the volume of comments and the sentiment expressed towards each topic (see FIGURE 7 and FIGURE 8). In terms of horizontal attention, the audience shows the highest interest in technological development (Topic 1) and the lowest interest in educational impact (Topic 3) (FIGURE 7). Vertically, the audience's affective tendencies towards the three topics generally fall into positive, neutral, and negative categories, while the proportions of these affective tendencies vary slightly (FIGURE 8). Technological development (Topic 1) elicits 43.1% positive emotions, 4.3% neutral emotions, and 53.3% negative emotions. Social influence (Topic 2) garners 34% positive emotions, 3.5% neutral emotions, and 62.3% negative emotions. Educational development (Topic 3) results in 45.3% positive emotions, 3.3% neutral emotions, and 52.2% negative emotions. We find the negative words

such as "Unemployment", "Job" and "Replace", which represent Chinese people's concerns about unemployment. At the same time, the words in Topic 3 represent Chinese people's great concern for educational issues.
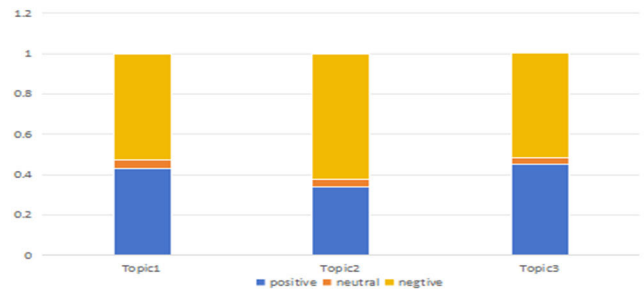

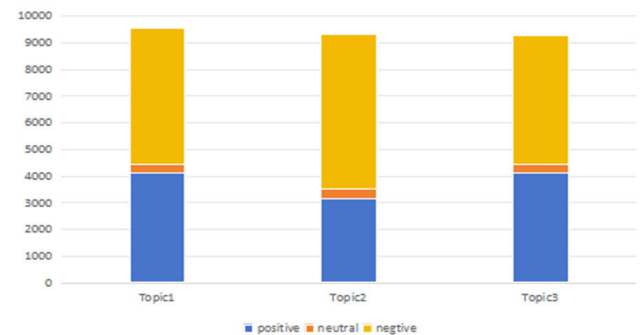**FIGURE 7.** Graph of the number of user comment threads.

FIGURE 8. User comment theme emotional tendency map.

V. SCIENTOMETRIC NANLYSIS BASED ON KNOWLEDGE MAPPING

The VOSviewer bibliometric tool is predominantly used in this paper for knowledge mapping. The China National Knowledge Infrastructure (CNKI) was chosen as the data source for the academic research conducted in China. The keyword "ChaGPT" was used, and the database was last updated on September 1, 2023, resulting in 1,025 records. However, the data obtained from the database without careful screening may contain duplications or data inconsistent with the literature's theme. Therefore, the data needs to be pre-processed before analysis, which ensures that the quality of the data does not influence the analysis results to maintain the effectiveness of the visualization analysis. This paper primarily utilizes the data cleaning "DEAN" process proposed by Pan et al. [57] to screen the literature data and ultimately obtain 996 valid documents. The valid documents are then imported into VOSviewer in Refworks format. In the VOSviewer function panel, we opt for the "Keyword" keyword co-occurrence analysis function, which generates a clear and intuitive visualization of the knowledge map.

VOSviewer software is a commonly used tool for analyzing and mapping scientific knowledge. It enables a visual

representation of the structural relationships of knowledge and provides insights into the evolution of the research field. VOSviewer offers various analysis capabilities for literature data, including country co-occurrence, institution co-occurrence, author co-occurrence, author co-citation, and literature co-citation analysis. In this study, the VOSviewer 1.6.11 research tool was used to visually analyze the co-occurrence of keywords. Keywords serve as indicators of the research field's focus, and high-frequency keywords often indicate research hotspots. FIGURE 9 demonstrates that larger circle nodes indicate a more frequent appearance of keywords, thereby representing prominent research hotspots; and the strength of association is depicted by the thickness of connecting lines, with thicker lines denoting frequent co-occurrence of keywords in the same literature; node colors represent different clusters and signify distinct research themes.
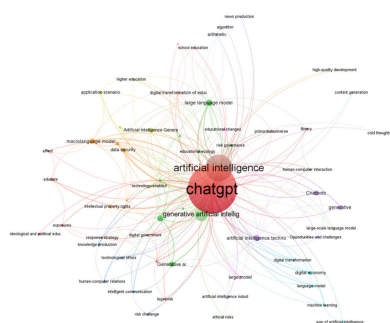

FIGURE 9. Keyword co-linear mapping.

There are overlapping keywords in the keyword covariance mapping, and calculations were performed using the Lepus formula to obtain a clear understanding of the specific keywords. Core keywords with a frequency of 8 or more were selected and presented in Table 5. Analysis of FIGURE 9 and Table 4 reveals several core keywords with frequencies of 805, 297, 98, and 26: ChatGpt, artificial intelligence, generative artificial intelligence, and large language models. These keywords are highly associated with others such as artificial intelligence technology, generative AI, macrolanguage models, and technology generative AI. The abundance of keywords indicates that Chinese scholars have conducted comprehensive and extensive research on ChatGPT. Moreover, there is a strong correlation between these keywords, with artificial intelligence technology, language models, and data security being prime areas of scholars' investigation.

FIGURE 10 shows that The literature related to ChatGPT has developed from 1 article in 2022 to 1025 articles in the current time of 2023. That is the birth of ChatGPT triggered an explosive research boom in the Chinese academic community. Furthermore, from FIGURE 11, it can be seen that the number of posts related to chat robots was less than 20 before 2015. Although the overall number of posts increased between 2015 and 2022, it also showed a decline

TABLE 5. List of high-frequency keywords for ChatGPT research in China (top 20).

| Serial Number	Keyword	Occurrences	Total link strength
1	ChatGPT	805	1176
2	artificial intelligence	297	668
3	generative artificial intelligence	98	253
4	large language model	26	102
5	artificial Intelligence technology	26	52
6	Generative AI	22	48
7	macrolanguage model	21	69
8	generative	19	21
9	chatbot	18	32
10	artificial intelligence generated content	16	59
11	data security	13	47
12	human-computer collaboration	13	41
13	digital economy	12	34
14	large model	12	26
15	digital transformation of education	11	51
16	general artificial intelligence	11	40
17	gpt-4	9	28
18	arithmetic	9	23
19	application scenario	9	19
20	educational change	8	29
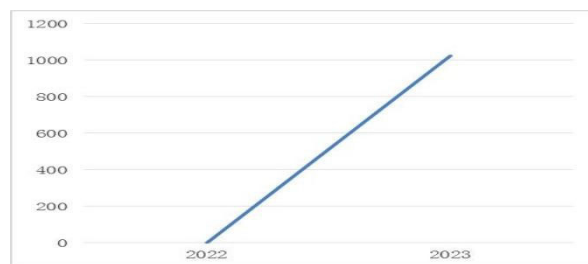
FIGURE 10. Posting of ChatGPT.

after 2018. But the expected publication volume in 2023 will reach an unprecedented level. This is related to the increase in the number of ChatGPT publications. This reflects that even in the context of China's ban on the use of ChatGPT, the Chinese academic community is still enthusiastic about researching ChatGPT. This also reflects that under the influence of ChatGPT, Chinese scholars are more focused on studying the AIGC.

FIGURE 12 shows the disciplinary distribution of publications related to ChatGPT. It is not difficult to find that
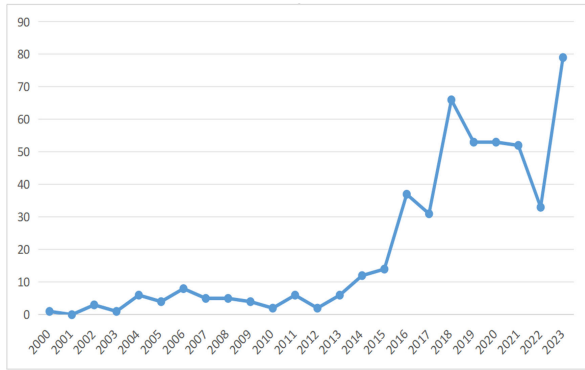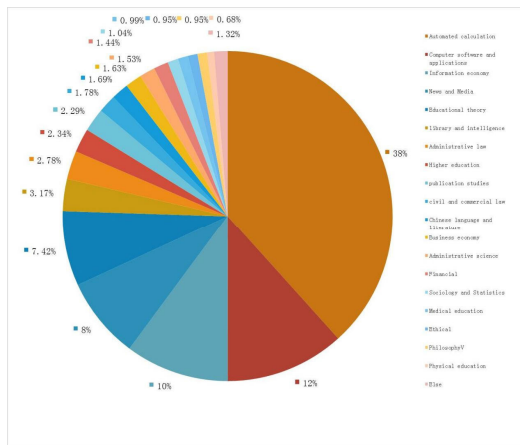
FIGURE 11. Chat robot posting status.

FIGURE 12. Discipline distribution map.

"automated calculation" accounts for the first place with 38%, followed by "Computer software and applications", "Information economy", "News and media", "Educational theory", "Library and intelligence", "Administrative law", "Higher education", "Publication studies", "Civil and commercial law", etc. This reflects the extensive research on ChatGPT in the Chinese academic community, which is similar to the topic of international research papers introduced in the introduction. This indicates that although China has banned the use of ChatGPT, the development trend of ChatGPT in both Chinese and international academic circles is roughly the same, and there is no fault or backwardness.

VI. DISCUSSION

Based on the research results, we draw the following conclusions:

1. China is highly concerned about the development of AIGC, such as ChatGPT, and artificial intelligence has had many impacts on human society. Although China prohibits the use of ChatGPT, there is a high level of attention paid to this type of artificial intelligence. In terms of time, when there is a breakthrough in ChatGPT technology or negative news appears, the Chinese public's attention to

ChatGPT will increase. In terms of region, regions with higher levels of economic and technological development pay more attention to ChatGPT. Additionally, the analysis of knowledge mapping reveals a gradual increase in discussions about chatbots among Chinese scholars. All of these indicate that China attaches great importance to the development of AIGC.

The reason for this is that AIGC has had an impact on all aspects of human society. In terms of attention hot spots, the keywords "company", "technology" and "industry" appear frequently, implying that Chinese people believe that the development of ChatGPT will greatly affect the development of Chinese technology industry. Furthermore, in terms of topic sentiment, the three themes within the functional domain—social development, technological development, and educational impact—are identified based on the analysis of public sentiment among users of social platforms. There are many studies on these three aspects. For instance, Biswat analyzed the results of ChatGPT's response to climate change. He believes that ChatGPT and other AI tools may play a key role in promoting our understanding of climate change and improving the accuracy of climate predictions [58]. Kocoń thought that ChatGPT, its functions, and its significant resonance in science, industry, and society will significantly impact our daily lives and technologies related to artificial intelligence [59]. Firat believed that ChatGPT can enhance the motivation and engagement of learners in automated teaching by providing personalized support, guidance, and feedback [60].

In China, many scholars link ChatGPT with various social disciplines, such as computer software and applications, information economy, news and media, educational theory, library and intelligence, Administrative law, and so on. Chinese research on ChatGPT is related to the underlying technology of the model, including artificial intelligence, generative artificial intelligence, chatbots, and large-scale language models. It also extends to areas such as digital government, intelligent communication, information resource management, and ethics, which are key aspects of ChatGPT's application. Clustering analysis further reveals that Chinese research on ChatGPT focuses on four main themes: technology, education, information intelligence, and ethics.

2. Chinese people are concerned that the development of AIGC, such as ChatGPT, will have a negative impact on society. In terms of sentiment index and attention hot spots, this study shows that although Chinese people are very satisfied with the use of ChatGPT, they still hold an anxious and worried attitude. In terms of knowledge mapping, although the word "data security" only ranks 11th in Table 5, it is the biggest hidden danger that scholars have considered, highlighting the importance of data security. However, Chinese people tend to have more negative emotions towards ChatGPT, which may be related to some negative news, such as AIGC replacing humans in certain positions, educational issues, ChatGPT leaking user information, and so on.

The emergence of ChatGPT presents significant challenges to human society. The introduction of new AI technologies, including ChatGPT, belonging to the new generation of AI technology, will have a profound impact on specific industries, jobs, and work types. It will notably replace monotonous, low-skilled, and procedural tasks. Konstantis's research shows that the vast majority are very or somewhat concerned that using ChatGPT may lead to unemployment [61]. Rice pointed out that many people are worried that ChatGPT will steal our ability to learn how to write [62]. Furthermore, there are still many defects in ChatGPT. Wach pointed out that ChatGPT has problems such as poor quality, lack of quality control, false information, deep forgery of content, and algorithm bias [63]. Of course, the leakage of data responds to people's panic (whether intentional or unintentional). The culprit that causes people to fear and panic may be the security, interests and other issues hidden behind artificial intelligence tools. So many countries have restricted the use of ChatGPT, such as China, Italy, and so on.

When people expect stronger AI, they also need to carefully consider reaching a consensus on ethical and responsible use [64]. Global discussions are underway regarding the ethics of AI, encompassing various concepts including transparency, justice, and fairness. However, significant differences persist in the interpretation of these principles. This is despite appeals for ethical frameworks and AI chatbots from organizations beyond the realms of education and healthcare. Regrettably, the efforts to develop and implement AI ethics have not yielded success and are frequently regarded as inconsequential, non-binding frameworks.

3. China is full of prospects for the future development of artificial intelligence such as ChatGPT. In terms of attention hot spot, the keywords "improvement" and "development" appear frequently, implying that Chinese people are very concerned about the development of AIGC, and even the future improvement and development of China. In terms of topic Sentiment, the words such as "Future", "Development", "Creation" and "Change" imply that the future development of AIGC will change human society and bring about tremendous growth. Additionally, in terms of knowledge mapping, scholars have foreseen its impact in various technology industries and are constantly calling for technological updates.

Technological innovation represents not only a darling of the capital market but also a catalyst for productivity advancement. ChatGPT emerged in the tech industry and quickly garnered praise from Chinese community platforms. Its introduction acted as a catalyst, once again propelling AI to the forefront and prompting pursuit from various domestic and international enterprises and organizations. For instance, in February 2023, Microsoft launched the latest versions of the Bing search engine and Edge browser, equipped with ChatGPT and fully integrated with Office, Azure cloud services, and other products. During the same period, Google unveiled Bard, a next-generation conversational AI system based on the Google LaMDA model. Baidu announced plans to conclude internal testing of the "Wenxin Yiyin" big model project. Additionally, domestic enterprises such as Alibaba and Jingdong confirmed their development or future plans to create similar products.

However, it is crucial to acknowledge that ChatGPT, as a novel phenomenon, presents various challenges, including factual errors, knowledge limitations, and biases based on common sense. Meyer pointed out that ChatGPT can generate bias from training data, such as nurses being female and doctors being male [65]. It encompasses broader risks associated with digital technology, including data source adherence, data utilization bias, misinformation propagation, and copyright disputes. Furthermore, previous technological advancements have demonstrated that transitioning from a technology's inception to increased productivity is not always straightforward.

VII. CONCLUSION AND PROSPECT

Although many countries and regions currently restrict the use of ChatGPT, their attention to AIGC, such as ChatGPT, has not decreased. Although ChatGPT is not without challenges, risks, and an impact on traditional practices, it is undeniably part of the technological trend. Therefore, we must embrace this technology and reap the numerous benefits it brings. However, there are many factors that limit the development of artificial intelligence, so we propose the following suggestions:

1. There should be an emphasis on encouraging and expediting the implementation and promotion of AIGC in various application scenarios. It is vital for new technologies to undergo practical testing and be effectively employed to foster their continued advancement. The broad applicability of AI technology necessitates the introduction of corresponding incentives to facilitate the implementation of ChatGPT in different scenarios.

The government can establish suitable experimental areas and try to apply AIGC to areas such as life, education, and work. Yang et al. believe that it is possible to rely on domestic scientific research institutions and state-owned technology enterprises to develop domestic ChatGPT-type open source platforms [66]. For example, on May 17, 2023, Guolian Group publicly declared its full integration of ChatGPT within their internal operations, enabling all employees to utilize it as personal work assistants on the internal management platform [67]. In terms of education, Adeshola pointed out that educational institutions can promote academic integrity by formulating clear policies and designing evaluations that include limited AI-generated texts [68]. Many regions have introduced ChatGPT into the classroom. A milestone occurred on June 1, 2023, when the Hong Kong University of Science and Technology became the first institution in Hong Kong to officially offer the Hong Kong University of Science and Technology version of ChatGPT to its students and faculty [69]. In the field

of medicine, Cheng believes that ChatGPT can be used to support the daily tasks of psychiatrists, such as completing medical records, promoting communication between clinical doctors and patients, improving academic works and reports, and so on [70]. Of course, this still requires a lot of practice and practice.

ChatGPT and chatbot technology, as the latest advancements in the new generation of AI, will continue to mature and see widespread application. Consequently, research in this field will also gain momentum. It is essential for scholars conducting research to ground their work in the reality of the national context, ensuring that their research aligns with national strategic needs and social development. This approach can contribute to the high-quality development and application of chatbot industry across various sectors.

2. The government has a significant role to play in addressing the emergence of AIGC such as ChatGPT. To begin, it is crucial for the government to adopt a balanced perspective on ChatGPT, acknowledging both its benefits and advantages as well as its potential drawbacks. A comprehensive and cautious approach should be maintained, encompassing the introduction of suitable policies to stimulate research, development, and implementation of the new generation of AI technology. Governments should strengthen cooperation among themselves. The development prospects of artificial intelligence are broad, so it cannot rely on a few countries or even one country, but rather on global cooperation and win-win outcomes. If the technology of AIGC is only in the hands of a few countries, it will cause a great blow to the balance of human society. Countries that master technology can establish branches in other countries to gain benefits and promote technology, in order to achieve common progress.

There is a pressing need to expedite the research, development, and implementation for the version belonging to one's own country of AIGC, such as ChatGPT. Currently, domestic efforts in technology research, development, and product advancement in this field lag behind those in the United States. Furthermore, ChatGPT has yet to be introduced in its Chinese version, and there is a scarcity of data sources to facilitate the collection, processing, and generation of Chinese information. Moreover, the perceived alignment of ChatGPT with U.S. political interests further complicates governments' relaxation of restrictions on its usage. To actively participate in and align with the trends of the new generation of artificial intelligence, it is imperative to accelerate the independent development of ChatGPT technology and products under governments' control. Governments should accelerate the research and development of independent and controllable technology systems, and be brave enough to explore and break through the chain of technology and industry.

3. Additionally, the establishment of a robust regulatory and safety system for ChatGPT should not be overlooked. Yang pointed out that governments around the world should strengthen their supervision of data quality, and government officials must continuously update chat-type databases to ensure the quality and capacity of system data [66]. Like any new technology, chatbots carry potential risks and hidden dangers, necessitating the implementation of a sound regulatory framework. The establishment of a collaborative governance mechanism involving multiple stakeholders, recognition of the importance of AI education and public awareness, as well as the acceleration of relevant training and education for professionals. The Artificial Intelligence Act needs to strive to keep up with the accelerating dynamics in the field of AI technology [71]. Countries need to unite to establish an organization to help establish relevant systems, which includes the enactment of laws and regulations, such as the Artificial Intelligence Law. At the same time, each country has the right to check whether the information of its own people is leaked, and so on. Overall, the new generation of AI technology is of utmost importance in every country, demanding our attention, a timely response, and efforts to achieve the goal of harm prevention.

REFERENCES
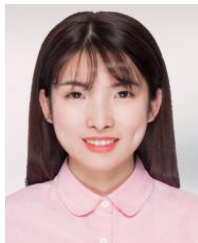
[1] L. Yunjiu, W. Wei, and Y. Zheng, "Artificial intelligence-generated and human expert-designed vocabulary tests: A comparative study," *SAGE Open*, vol. 12, no. 1, Jan. 2022, Art. no. 215824402210821.

[2] H. Bansal and R. Khan, "A review paper on human computer interaction," *Int. J. Adv. Res. Comput. Sci. Softw. Eng.*, vol. 8, no. 4, p. 53, Apr. 2018.

[3] B. Abu Shawar and E. Atwell, "Chatbots: Are they really useful?" *J. Lang. Technol. Comput. Linguistics*, vol. 22, no. 1, pp. 29–49, Jul. 2007.

[4] P. Rospigliosi, "Artificial intelligence in teaching and learning: What questions should we ask of ChatGPT?" *Interact. Learn. Environments*, vol. 31, no. 1, pp. 1–3, Jan. 2023.

[5] G.-J. Hwang and C.-Y. Chang, "A review of opportunities and challenges of chatbots in education," *Interact. Learn. Environments*, vol. 31, no. 7, pp. 4099–4112, Oct. 2023.

[6] M. J. Ahn and Y.-C. Chen, "Digital transformation toward AI-augmented public administration: The perception of government employees and the willingness to use AI in government," *Government Inf. Quart.*, vol. 39, no. 2, Apr. 2022, Art. no. 101664.

[7] A. Guleria, K. Krishan, V. Sharma, and T. Kanchan, "ChatGPT: Forensic, legal, and ethical issues," *Med., Sci. Law*, vol. 64, no. 2, pp. 150–156, Apr. 2024.

[8] L. Xu, L. Sanders, K. Li, and J. C. L. Chow, "Chatbot for health care and oncology applications using artificial intelligence and machine learning: Systematic review," *JMIR Cancer*, vol. 7, no. 4, Nov. 2021, Art. no. e27850.

[9] Econ. News. (2023). *Why is ChatGPT Popular Globally With Daily Activity Exceeding 10 Million Daily?*. [Online]. Available: https://www.jwview.com/jingwei/html/01-31/524486.shtml

[10] Y. Liu. (2023). *Why Was ChatGPT Banned From Sweeping the Campus*. [Online]. Available: https://edu.sina.com.cn/l/2023-02-17/doc-imyfynkx7068095.shtml?tj=cxvertical

[11] Q. Yingyi. *Artificial Intelligence Will Eliminate China's Educational Advantages*. Accessed: May,4, 2023. [Online]. Available: https://baijiahao.baidu.com/s?ID=1757761472656332970&wfr=spider&for=pc

[12] B. Pang and L. Lee, "Opinion mining and sentiment analysis," *Found. Trends Inf. Retr.*, vol. 2, nos. 1–2, pp. 1–135, 2008.

[13] B. Liu, "Sentiment analysis and opinion mining," *Synth. Lectures Hum. Lang. Technol.*, vol. 5, no. 1, pp. 1–167, May 2012.

[14] H. Xie, W. Lin, S. Lin, J. Wang, and L.-C. Yu, "A multi-dimensional relation model for dimensional sentiment analysis," *Inf. Sci.*, vol. 579, pp. 832–844, Nov. 2021.

[15] J. Serrano-Guerrero, F. P. Romero, and J. A. Olivas, "Fuzzy logic applied to opinion mining: A review," *Knowl.-Based Syst.*, vol. 222, Jun. 2021, Art. no. 107018.

[16] K. Cortis and B. Davis, "Over a decade of social opinion mining: A systematic review," *Artif. Intell. Rev.*, vol. 54, no. 7, pp. 4873–4965, Oct. 2021.

[17] M. E. Basiri, S. Nemati, M. Abdar, S. Asadi, and U. R. Acharrya, "A novel fusion-based deep learning model for sentiment analysis of COVID-19 tweets," *Knowl.-Based Syst.*, vol. 228, Sep. 2021, Art. no. 107242.

[18] M. Usama, B. Ahmad, E. Song, M. S. Hossain, M. Alrashoud, and G. Muhammad, "Attention-based sentiment analysis using convolutional and recurrent neural network," *Future Gener. Comput. Syst.*, vol. 113, pp. 571–578, Dec. 2020.

[19] R. Ghasemi, S. A. Ashrafi Asli, and S. Momtazi, "Deep Persian sentiment analysis: Cross-lingual training for low-resource languages," *J. Inf. Sci.*, vol. 48, no. 4, pp. 449–462, Aug. 2022.

[20] M. S. Divate, "Sentiment analysis of Marathi news using LSTM," *Int. J. Inf. Technol.*, vol. 13, no. 5, pp. 2069–2074, Oct. 2021.

[21] N. Majumder, D. Hazarika, A. Gelbukh, E. Cambria, and S. Poria, "Multimodal sentiment analysis using hierarchical fusion with context modeling," *Knowl.-Based Syst.*, vol. 161, pp. 124–133, Dec. 2018.

[22] S. Poria, N. Majumder, D. Hazarika, E. Cambria, A. Gelbukh, and A. Hussain, "Multimodal sentiment analysis: Addressing key issues and setting up the baselines," *IEEE Intell. Syst.*, vol. 33, no. 6, pp. 17–25, Nov. 2018.

[23] E. Cambria, "Affective computing and sentiment analysis," *IEEE Intell. Syst.*, vol. 31, no. 2, pp. 102–107, Mar. 2016.

[24] F. A. Acheampong, H. Nunoo-Mensah, and W. Chen, "Transformer models for text-based emotion detection: A review of BERT-based approaches," *Artif. Intell. Rev.*, vol. 54, no. 8, pp. 5789–5829, Dec. 2021.

[25] S. A. Abdu, A. H. Yousef, and A. Salem, "Multimodal video sentiment analysis using deep learning approaches, a survey," *Inf. Fusion*, vol. 76, pp. 204–226, Dec. 2021.

[26] G. Chandrasekaran, T. N. Nguyen, and J. Hemanth D., "Multimodal sentimental analysis for social media applications: A comprehensive review," *WIREs Data Mining Knowl. Discovery*, vol. 11, no. 5, p. e1415, Sep. 2021.

[27] T. Al-Moslmi, N. Omar, S. Abdullah, and M. Albared, "Approaches to cross-domain sentiment analysis: A systematic literature review," *IEEE Access*, vol. 5, pp. 16173–16192, 2017.

[28] M. M. Agüero-Torales, J. I. Abreu Salas, and A. G. López-Herrera, "Deep learning and multilingual sentiment analysis on social media data: An overview," *Appl. Soft Comput.*, vol. 107, Aug. 2021, Art. no. 107373.

[29] L. Jiang, J. Shen, and R. Yi, "Sentiment analysis of user comment data of e-commerce platform based on LDA theme analysis model–taking fresh agricultural product apple as an example," *Technol. market*, vol. 28, pp. 74–76, Oct. 2021.

[30] D. Blei and J. Lafferty, *Text Mining: Classification, Clustering, and Applications*. Boca Raton, FL, USA: CRC Press, 2009, p. 34.

[31] A. Chaney and D. Blei, "Visualizing topic models," in *Proc. ICWSM*, vol. 6, 2012, pp. 419–422.

[32] B. Ozyurt and M. A. Akcayol, "A new topic modeling based approach for aspect extraction in aspect based sentiment analysis: SS-LDA," *Expert Syst. Appl.*, vol. 168, Apr. 2021, Art. no. 114231.

[33] Z. Li, D. Wang, and Y. Wu, "Sentiment analysis on Chinese movie comment with LDA model," in *Proc. 2nd Int. Conf. Big Data Economy Inf. Manage. (BDEIM)*, Dec. 2021, pp. 424–428.

[34] C. Lin and Y. He, "Joint sentiment/topic model for sentiment analysis," in *Proc. 18th ACM Conf. Inf. Knowl. Manage.*, Nov. 2009, pp. 375–384.

[35] F. Xianghua, L. Guo, G. Yanyan, and W. Zhiqiang, "Multi-aspect sentiment analysis for Chinese online social reviews based on topic modeling and HowNet lexicon," *Knowl.-Based Syst.*, vol. 37, pp. 186–195, Jan. 2013.

[36] A. García-Pablos, M. Cuadros, and G. Rigau, "W2 VLDA: Almost unsupervised system for aspect based sentiment analysis," *Expert Syst. Appl.*, vol. 91, pp. 127–137, Jan. 2018.

[37] B. Sun, H. Mao, and C. Yin, "How to identify product defects and segment consumer groups on an online auto forum," *Int. J. Consum. Stud.*, vol. 46, no. 6, pp. 2270–2287, Nov. 2022.

[38] J. R. Saura, P. Palos-Sanchez, and A. Grilo, "Detecting indicators for startup Bus. Success: Sentiment analysis using text data mining," *Sustainability*, vol. 11, no. 3, p. 917, Feb. 2019.

[39] J. R. Saura, D. Ribeiro-Soriano, and P. Zegarra Saldaña, "Exploring the challenges of remote work on Twitter users' sentiments: From digital technology development to a post-pandemic era," *J. Bus. Res.*, vol. 142, pp. 242–254, Mar. 2022.

[40] J. Qiu, *Bibliometrics Science and Technology Literature*. Beijing, China: Science and Technology Literature Press, 1988.

[41] N. J. van Eck and L. Waltman, "Citation-based clustering of publications using CitNetExplorer and VOSviewer," *Scientometrics*, vol. 111, no. 2, pp. 1053–1070, May 2017.

[42] Y. Yu, Y. Li, Z. Zhang, Z. Gu, H. Zhong, Q. Zha, L. Yang, C. Zhu, and E. Chen, "A bibliometric analysis using VOSviewer of publications on COVID-19," *Ann. Transl. Med.*, vol. 8, no. 13, p. 816, Jul. 2020.

[43] X. Ding and Z. Yang, "Knowledge mapping of platform research: A visual analysis using VOSviewer and CiteSpace," *Electron. Commerce Res.*, vol. 22, no. 3, pp. 787–809, Sep. 2022.

[44] A. Nandiyanto, D. Al Husaeni, and D. Al Husaeni, "A bibliometric analysis of chemical engineering research using vosviewer and its correlation with COVID-19 pandemic condition," *J. Eng. Sci. Technol.*, vol. 16, pp. 4414–4422, Mar. 2021.

[45] J. T. McAllister, L. Lennertz, and Z. Atencio Mojica, "Mapping a discipline: A guide to using VOSviewer for bibliometric and visual analysis," *Sci. Technol. Libraries*, vol. 41, no. 3, pp. 319–348, Jul. 2022.

[46] D. M. Blei, A. Y. Ng, and M. I. Jordan, "Latent Dirichlet allocation," *J. Mach. Learn. Res.*, vol. 3, pp. 993–1022, Mar. 2003.

[47] J. Wang, F. Ji, B. Liu, N. Wang, H. Yin, and F. Zhang, "Research on mass news classification algorithm based on spark," in *Proc. Int. Conf. Big Data Artif. Intell. Softw. Eng. (ICBASE)*, Oct. 2020, pp. 408–414.

[48] Y. Ma, C. Ling, and J. Wu, "Exploring the spatial distribution characteristics of emotions of Weibo users in Wuhan waterfront based on gender differences using social media texts," *ISPRS Int. J. Geo-Inf.*, vol. 9, no. 8, p. 465, Jul. 2020.

[49] Y. Ding, R. Li, Y. Zhen, and W. Li, "Research on semi-automatic construction method of high-speed train," *Mach. Des. Res.*, vol. 36, pp. 185–189, Nov. 2020.

[50] P. Turney, *Thumbs Up or Thumbs Down? Semantic Orientation Applied To Unsupervised Classification of Reviews*. Stroudsburg, PA, USA: Association for Computational Linguistics, 2002.

[51] R. Atenstaedt, "Word cloud analysis of theBJGP," *Brit. J. Gen. Pract.*, vol. 62, no. 596, p. 148, Mar. 2012.

[52] C. McNaught and P. Lam, "Using wordle as a supplementary research tool," *Qualitative Rep.*, vol. 15, pp. 630–643, Nov. 2014.

[53] ChatGPT plugins. *OpenAI*. Accessed: Apr. 10, 2023. [Online]. Available: https://openai.com/blog/chatgpt-plugins

[54] T. Jennifer. (2023). *ChatGPT Bug Leaked Users' Conversation Histories*. Accessed: Apr. 5, 2023. [Online]. Available: https://www.bbc.com/news/technology-65047304

[55] *ChatGPT Outage: Here's What Happened*. Accessed: Apr. 4, 2023. [Online]. Available: https://openai.com/blog/march-20-chatgpt-outage

[56] K. Michael. *OpenAI: Sorry, ChatGPT Bug Leaked Payment Info To Other Users*. Accessed: Apr. 5, 2023. [Online]. Available: https://www.pcmag.com/news/openai-sorry-chatgpt-bug-leaked-payment-info-to-other-users

[57] P. Wei, Z. Peng, H. Jinquan, M. Dongmei, and L. Yin, "Detection of research hotspots in the field of health information based on the data cleansing 'DEAN' process," *J. Modern Inf.*, vol. 38, pp. 75–79, Dec. 2018.

[58] S. S. Biswas, "Potential use of chat GPT in global warming," *Ann. Biomed. Eng.*, vol. 51, no. 6, pp. 1126–1127, Jun. 2023.

[59] J. Kocoń et al., "ChatGPT: Jack of all trades, master of none," *Inf. Fusion*, vol. 99, 2023, Art. no. 101861.

[60] M. Firat, "How chat GPT can transform autodidactic experiences and open education," in *Department of Distance Education*. Eskişehir, Turkey: Anadolu Unive, 2023.

[61] K. Konstantis, A. Georgas, A. Faras, K. Georgas, and A. Tympas, "Ethical considerations in working with ChatGPT on a questionnaire about the future of work with ChatGPT," *AI Ethics*, Jun. 2023, doi: 10.1007/s43681-023-00312-6.

[62] S. Rice, S. R. Crouse, S. R. Winter, and C. Rice, "The advantages and limitations of using ChatGPT to enhance technological research," *Technol. Soc.*, vol. 76, Mar. 2024, Art. no. 102426.

[63] K. Wach, C. D. Duong, J. Ejdys, R. Kazlauskaitė, P. Korzynski, G. Mazurek, J. Paliszkiewicz, and E. Ziemba, "The dark side of generative artificial intelligence: A critical analysis of controversies and risks of ChatGPT," *Entrepreneurial Bus. Econ. Rev.*, vol. 11, no. 2, pp. 7–30, 2023.

[64] T. Wu, S. He, J. Liu, S. Sun, K. Liu, Q.-L. Han, and Y. Tang, "A brief overview of ChatGPT: The history, status quo and potential future development," *IEEE/CAA J. Autom. Sinica*, vol. 10, no. 5, pp. 1122–1136, May 2023.

[65] J. G. Meyer, R. J. Urbanowicz, P. C. N. Martin, K. O'Connor, R. Li, P.-C. Peng, T. J. Bright, N. Tatonetti, K. J. Won, G. Gonzalez-Hernandez, and J. H. Moore, "ChatGPT and large language models in academia: Opportunities and challenges," *BioData Mining*, vol. 16, no. 1, p. 20, Jul. 2023.

[66] L. Yang and J. Wang, "Factors influencing initial public acceptance of integrating the ChatGPT-type model with government services," *Kybernetes*, Aug. 2023, doi: 10.1108/K-06-2023-1011.

[67] JIEMIAN. (2023). *Guolian Group: The Company Has Fully Integrated Into ChatGPT Internally*. Accessed: May, 17, 2023. [Online]. Available: https://finance.eastmoney.com/a/202305172724475767.html

[68] I. Adeshola and A. P. Adepoju, "The opportunities and challenges of ChatGPT in education," *Interact. Learn. Environ.*, Sep. 2023, doi: 10.1080/10494820.2023.2253858.

[69] (2023). *The Paper Observation|Hong Kong Universities Are Embracing ChatGPT and Busy Preparing for New Semester Changes During the Summer Vacation*. Accessed: Aug. 8, 2023. [Online]. Available: https://www.thepaper.cn/newsDetail_forward_24072878

[70] S. Cheng, C. Chang, W. Chang, H. Wang, C. Liang, T. Kishimoto, J. P. Chang, J. S. Kuo, and K. Su, "The now and future of ChatGPT and GPT in psychiatry," *Psychiatry Clin. Neurosciences*, vol. 77, no. 11, pp. 592–596, Nov. 2023.

[71] P. Hacker, A. Engel, and M. Mauer, "Regulating ChatGPT and other large generative AI models," in *Proc. ACM Conf. Fairness, Accountability, Transparency*, Jun. 2023, pp. 1112–1123.

ZIQI LIANG is currently pursuing the bachelor's degree in digital printing engineering with Guangzhou Vocational and Technical University of Science and Technology, Guangzhou, Guangdong, China.

His research interests include conversational sentiment analysis and affective dialogue generation and opinion mining classification.

YUHUA FANG was born in Hubei, China, in 1995. He received the B.S. degree in English language and literature from Wuhan City College, Wuhan, China, in 2017, and the M.S. degree from China University of Geosciences, Wuhan, in 2020. He is currently pursuing the Ph.D. degree in applied linguistics with Universiti Teknologi Malaysia, Johor Bahru, Malaysia.

His recent research interests include translation and literary studies based on digital humanities and the application of artificial intelligence in translation practice.

JINQIAO ZHOU was born in September 1997. She received the bachelor's degree from Jiaxing University, Zhejiang, China. She is currently pursuing the master's degree with Zhejiang Normal University, Zhejiang. She is also mainly studying communication studies.

ZHANXI ZHOU is currently pursuing the Graduate degree with Northern Arizona University, USA.

His research interests include the research of machine learning technology, the development, and application of data mining.

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