Current Research Status and Future Prospects of User Profiles in Library and Information Science (Postprint)

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Date: 2023-07-26T00:00:00+00:00

Abstract

[Purpose/Significance] With the rapid development of big data and artificial intelligence, research on user profiling has quietly emerged. Reviewing and organizing its current research status is of important theoretical and practical significance for promoting the long-term development of user profiling. [Method/Process] Based on the CNKI database and Web of Science database, this study uses visualization tools such as CiteSpace and VOSviewer to conduct quantitative analysis on publication volume, research institutions, cited journals, research hotspots, and density of research hotspots in current user profiling research within the library and information science field, and employs mind mapping to specifically elaborate on research themes, research algorithms and technologies, model construction, and practice and application of user profiling in the library and information science field both domestically and internationally. [Result/Conclusion] As an emerging research tool, research on user profiling in China is still relatively weak, with considerable room for exploration. Future research on user profiling should focus on: broadening research themes of user profiling, emphasizing behavioral analysis in user profiling, and optimizing research models of user profiling.

Full Text

ChinaXiv Partner Journal, Vol. 63, No. 7, April 2019

Research Status and Prospects of User Portraits in Library and Information Science at Home and Abroad

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Abstract: [**Purpose/Significance**] With the rapid development of big data and artificial intelligence, research on user portraits has quietly emerged. Reviewing and combing through its current research status holds important theoretical and practical significance for promoting the long-term development of user portraits. [**Method/Process**] Based on the China Knowledge Network (CNKI) database and Web of Science, this study employs visualization tools such as CiteSpace and Vosviewer to conduct quantitative analysis of publication volume, research institutions, cited journals, research hotspots, and hotspot density in user portrait research within the library and information science field. Mind mapping is used to elaborate on research themes, algorithms and techniques, model construction, and practical applications of user portraits in library and information science at home and abroad. [**Result/Conclusion**] As an emerging research tool, user portrait research in China remains relatively weak with considerable room for exploration. Future research should focus on broadening research themes, emphasizing behavioral analysis, and optimizing research models.

Classification Number: G250
Keywords: user portrait, social network analysis, library and information science, mind mapping
DOI: 10.13266/j.issn.0252-3116.2019.07.015

The 13th Five-Year Plan explicitly proposes the important concept of implementing a national big data strategy: "Deepen the innovative development and in-depth application of big data across various industries, and accelerate technical breakthroughs in key areas such as massive data collection, cleaning, systematic analysis, visualization, and privacy protection." Along with the explosive growth of data, how to utilize big data to provide more precise services for people has become a widespread concern. In recent years, with advancements in artificial intelligence fields such as data mining, algorithmic computation, machine learning, and neural network models, user portraits have gained widespread attention as a new tool. A user portrait is an independent, concrete model that describes user interests, hobbies, and characteristics, with the goal of extracting personalized tag information from large volumes of user data. This paper tracks research achievements in library and information science at home and abroad, deeply examines the development status and future trends of user portraits in this field, and provides references and insights for subsequent research based on an integrated qualitative and quantitative study of user portraits.

1. Research Methods and Data Sources

1.1 Research Methods

This paper employs a combination of qualitative and quantitative methods to analyze user portraits in library and information science. For quantitative analysis, we fully utilize computer visualization analysis software (CiteSpace, Vosviewer) to analyze journal papers on user portraits in the library and information science field, including publication volume, cited journal sources, keywords, and research frontiers and hotspots, in order to intuitively, comprehensively, and accurately reveal the research landscape of this field. For qualitative analysis, we use mind maps to analyze the research themes, relevant algorithms, knowledge structure systems, model construction, and practical applications of user portraits in this field, exploring the current development status and gaining insights into future development directions to lay a theoretical foundation for subsequent research.

1.2 Data Sources

The English terms corresponding to "user portrait" mainly include: user portrait, user profile, user profiling, persona, etc. Using these different forms, we conducted title searches in the Web of Science database with the search date set as September 3, 2017. The search formula was: (SU=Information Science Library Science) and (TS="user portrait") or ("user profile") or ("user profiling") or ("Persona") or (TI="user portrait") or ("user profile") or ("user profiling") or ("Persona"), with article as the document type and research fields limited to SOCIAL SCIENCE and SOCIAL TECHNOLOGY. After removing invalid data, we retrieved 195 relevant papers. Domestic user portrait research literature mainly came from CNKI's China Journal Full-text Database, China Doctoral and Master's Dissertation Database, and China Conference Paper Database. We used advanced search with the following criteria: (Subject=user portrait) OR (Subject=group portrait) OR (Subject=personal portrait) OR (Keyword=user portrait) OR (Keyword=group portrait) OR (Keyword=personal portrait) OR (Title=user portrait) OR (Title=group portrait) OR (Title=personal portrait), with the search date set as April 20, 2017, and literature classification limited to library and information science and digital libraries. After removing invalid data, we retrieved relevant literature.

2. Quantitative Analysis of User Portrait Research in Library and Information Science

2.1 Analysis of Publication Volume

Sorting and counting the number of relevant literature on user portraits in library and information science can clearly reflect the research status and level in this field. Foreign research on user portraits began in 1975, while domestic research in library and information science and archival science started relatively

later, beginning in 2014. To more clearly understand the annual distribution of publications in this field, this paper presents a year distribution chart of relevant research papers on user portraits in library and information science at home and abroad, as shown in Figure 1 [Figure 1: see original paper].

As shown in Figure 1, domestic research on user portraits in this field originated with the paper "Library Information Marketing Strategy Based on Big Data" [1], which accurately positioned library users' information needs through data screening and mining to implement and formulate precise marketing strategies and improve marketing efficiency. Although user portrait research started late in China, it has developed rapidly, reaching its peak in 2017, suggesting that the number of relevant publications will continue to rise in the future. Foreign research on user portraits started earlier and has shown a consistent upward trend over time.

From Figure 1, we can identify three development stages: (1) 1975-2001: Foreign user portrait research was in a low-speed growth phase, focusing mainly on applying user portraits to government information policy formulation, digital libraries, literature retrieval, and management information systems. This stage was characterized by fewer researchers, immature theories and models, and slow literature growth. (2) 2002-2014: With the rapid development of information technology and artificial intelligence, intelligent recommendation of network information became increasingly important, requiring tools and methods including user portraits to mine and analyze user information behavior. During this period, models, algorithms, and application scope continuously expanded, focusing on model construction and personalized services in digital libraries and archives using diverse methods such as neural network algorithms, collaborative filtering algorithms, and clustering methods. The notable feature of this stage was the rapid increase in relevant publications. (3) Since 2016: User portrait research has entered a steady growth phase, with research fields expanding to medicine, telecommunications, real estate, and marketing, employing flexible and diverse analysis methods including logistics regression, k-means algorithms, and conditional random field methods. This stage is characterized by significant fluctuations in publication volume and an upward trend in literature growth.

2.2 Research Institutions

Research institutions represent the diffusion sources of knowledge production, organization, and dissemination in a discipline. Analyzing research institutions can evaluate their academic influence and overall competitive strength in the industry, providing decision-making references for future study abroad, further education, talent introduction, and cooperation [2]. Using CiteSpace software, we analyzed research institutions in library and information science at home and abroad and organized the output data. Major domestic research institutions include the Chinese Academy of Sciences and City University of Hong Kong, which are important strongholds for user portrait research and centers for theoretical system development. Major foreign research institutions include

the University of California, Indiana University, and the University of Hawaii at Manoa.

2.3 Analysis of Cited Journals

The citation volume of academic journals not only reflects their main content but also determines their academic influence, providing decision-making references for journal subscriptions and author submissions while revealing the journal's academic status in the field. This paper conducted statistical analysis of cited journals in user portrait research in library and information science at home and abroad. Foreign literature journal statistics covered 1900-2018 in the social sciences category, with nine journals listed as cited journals for foreign user portrait research. Domestic cited journals in library and information science include eight journals, as shown in Table 1 .

Table 1. Distribution of Cited Journal Sources

Domestic Journals	Foreign Journals
Library and Information Science	Lecture Notes in Computer Science
Library Theory and Practice	Lecture Notes in Artificial Intelligence
Digital Library Forum	Communication in Computer and Information Science
Library and Information Service	Information Processing & Management
Information Science: Theory and Application	Journal of Information Science
Library Science Research	Computer in Human Behavior
Journal of the China Society for Scientific and Technical Information	PLOS ONE
Information Science	IEEE Information Conference on Fuzzy System
	Advances in Intelligence Systems and Computing

As shown in Table 1, domestic user portrait literature mainly comes from core journals such as *Information Science: Theory and Application*, *Journal of Academic Libraries*, *Information Science*, and *Library and Information Service*. Foreign user portrait research in library and information science mainly comes from *Lecture Notes in Computer Science*, *Journal of Information Science*, and *Information Processing & Management*. Researchers seeking to understand the theoretical and methodological systems and model construction in this field can systematically study and read relevant academic literature in library and information science.

2.4 Analysis of Research Frontiers and Hotspots

Keyword clustering can clearly reveal research frontiers and hotspots in a field. Using CiteSpace software, we conducted cluster analysis of keywords in user portrait research in library and information science at home and abroad, with results shown in Figure 2 [Figure 2: see original paper] and Figure 3 [Figure 3: see original paper].

In Figures 2 and 3, each circle and node represents high-frequency keywords in the field, with circle and node size indicating the intensity of research hotspots—larger circles represent stronger intensity. In Figure 2, "social media," "system," "model," "persona," "internet," and "folksonomy" have become research hotspots in user portraits. Figure 3 shows that centered on user portraits, "big data," "data mining," "recommendation system," "precision marketing," "user," and "portrait" have become domestic research hotspots. Using CiteSpace visualization analysis clearly reveals that user portraits occupy an important position in library and information science at home and abroad and remain a topic of scholarly attention.

2.5 Research Hotspot Density Analysis

Vosviewer is a JAVA-based cross-platform scientific knowledge mapping tool primarily used for analyzing bibliometric networks, such as constructing publication, author, and journal maps based on supply networks or keyword term maps based on co-occurrence networks. This paper imported literature resources from Web of Science and CNKI into Vosviewer for data conversion and processing, set corresponding values, and mapped the density view of research hotspots in user portraits in library and information science at home and abroad (see Figure 4 [Figure 4: see original paper]). In Figure 4, circle range and font size reflect the density of research hotspots—larger circles and fonts indicate greater density, while smaller fonts and circles indicate lower density.

Domestically, research on user portraits in library and information science focuses more on "user portrait," "library," "big data," "user preference," "knowledge discovery," "association analysis," and "personalized needs." Foreign research centers on "user profile" and expands outward to include "persona," "data," "internet," "technique," "service," and "library."

3. Research on User Portraits in Library and Information Science

British scholar Tony Buzan created a portable thinking tool—the mind map—which combines visual logic with thinking logic through graphic techniques, enabling simultaneous operation of both brain hemispheres. Mind maps outline human thinking using pictures and lines to form a divergent structure that conforms to the brain's divergent thinking, allowing free expression of ideas. This paper uses mind maps to analyze four major aspects of user portraits: themes,

algorithms and techniques, model construction, and practice and application, aiming to clearly reveal the research status of this field, as shown in Figure 5 [Figure 5: see original paper].

3.1 Research Themes in User Portraits

Using the CiteSpace visualization tool to cluster keywords in user portrait research in library and information science at home and abroad, and Vosviewer for density analysis of high-frequency keywords, combined with our literature review, we find that current research themes mainly include big data, social networks, and libraries.

3.1.1 Domestic Research Themes In the big data domain, research focuses on hot public opinion and information marketing strategies. Yang Zhan [3] conducted big data analysis of hot public opinion by tracking and mining news data over time, using the Hadoop platform to analyze hot topics and associating user comment data with existing hotspots to provide better precision services for enterprises and governments. In the digital library domain, research has addressed digital library resource recommendation models, knowledge discovery services, and reading recommendation systems. Chen Huixiang et al. [4] analyzed foreign library user portraits from perspectives of definition, composition, algorithms, model construction, and application practice, offering constructive suggestions for better development of China's library field based on foreign experience. Wang Lingxiao et al. [5] examined social Q&A communities in the social network domain, analyzing community user behavior characteristics and constructing user portraits for social Q&A communities.

3.1.2 International Research Themes M. Sara et al. [6] constructed user portraits based on friendship recommendation platforms in social networks, where the most basic relationship between social network members is friendship, and friend pairing is the most reasonable way for people to recommend to each other. By mining the model to discover the influence degree of different factors affecting friendship formation, they extracted real user information in social networks, analyzed model-based data, and ultimately designed a matching and recommendation system for users, verifying the results through experiments. P. Karl et al. [7] analyzed digital library user portraits based on adaptive knowledge management methods. By investigating information retrieval situations of users in the digital library's internal network and using the power law method for data processing, they established a constant retrieval pattern, developed a mental model of web users based on data measurement and analysis, and achieved classification of different user groups for precise recommendations.

3.2 Algorithms and Techniques for User Portraits

With the development of big data and artificial intelligence, relevant algorithms and techniques for user portraits in different fields have matured, and their

application in library and information science has become widespread. By using algorithms and techniques to analyze and process big data information, we can mine users' potential needs based on their characteristics and attributes to provide precise, dynamic information services.

3.2.1 Domestic Algorithms and Techniques User portrait model construction and practical application are inseparable from their underlying algorithms and techniques. This paper provides a detailed review of domestic algorithms and techniques in library and information science, where currently mature algorithms include clustering algorithms and machine learning methods. Zhu Bai [8] applied clustering algorithms to construct personalized tags for user portraits, segmenting users into groups. Han Meihua et al. [9] used machine learning methods to study the relationship between user online behavior and depressive emotions, forming a user depression emotion dictionary. Zhang Jun [10] employed natural language processing technology and latent semantic models, using semantic information attributes and user portrait needs to adopt appropriate measurement modes and provide precise recommendations through latent semantic models.

3.2.2 International Algorithms and Techniques M. Amoretti et al. [11] proposed a universal profiling and recommendation (UPR) method based on context-aware theory, which constructs approximate user descriptions by revealing the relationship between individual and group behaviors, uses k-means algorithms to cluster users, finds user preferences and interests, and filters information to configure matching information for users, thereby achieving personalized recommendations. S. Kano et al. [12] used conditional random fields to analyze conditional information in user portrait data—if the information contains required data attributes, specific information is automatically preserved in dataset files. H. Movahedian et al. [13] proposed a new recommendation system based on similarity between user portrait profiles, generating user portrait configuration files by discovering frequently generated tag patterns. Tag patterns are divided into unrelated and related patterns representing different user preferences. By determining the basic meaning of tags, mapping them to semantic entities in external knowledge bases, and translating tag profiles into semantic profiles, this method better reflects user interest performance and achieves better recommendation effects compared to existing methods.

3.3 Model Construction for User Portraits

User portrait development is closely related to information technology and artificial intelligence development. Model construction has become a frontier hotspot in recent user portrait research, primarily involving data collection and organization, analysis of user behavior characteristics, and ultimate construction of user portrait models.

3.3.1 Domestic Model Construction Yin Xiangquan et al. [14] analyzed user information behavior by modeling and analyzing library reader user data to identify main factors affecting user behavior, providing data support for better library development. Wang Lingxiao et al. [5] constructed a model for social Q&A communities based on user portraits: extracting activity indicators of social Q&A community users from massive user data, then constructing user portraits based on user tags (user experience, user participation, answer quality, and user development trends). Zhang Jun [10] proposed a three-step model construction process for library user portraits: first, data collection, mainly including network behavior data, service behavior data, and user content preference data; second, modeling based on user behavior characteristics, which involves fully applying collected data and using machine learning algorithms to build user behavior tags and apply mathematical models to predict user behavior and interests; third, constructing user portraits by analyzing relevant data and extracting user tags based on behavior characteristics, psychological characteristics, and interests.

3.3.2 International Model Construction S. Laine et al. [16] noted that in systems, user portraits are determined by two types of information: available information permanently associated with specific individuals, and contextual information related to specific queries that mainly describes expected user characteristics. Existing user models fall into two categories: empirical quantitative models and analytical cognitive models. User modeling functions aim to recognize and identify various personal characteristics of users. Based on these characteristic information and model classifications, models can be constructed, with main components including five parts: USER (determining user status), UGOAL (understanding user goals), KNOW (determining user knowledge status on-site), IRS (determining user familiarity with IR systems), and BACK (determining user background).

3.4 Services and Applications of User Portraits

User portrait resources in library and information science can be roughly divided into text, video, audio, datasets, images, and web pages. With the advent of the big data and artificial intelligence era, datasets, user information behavior sets, and semantic information have enriched and improved the content and structure of user portraits. Visualization maps show that user portraits focus on personalized recommendation, personalized needs, user preferences, and personalized services, primarily involving libraries, big data, and related fields. This paper analyzes the services, practice, and applications of user portraits in library and information science to promote better development in this field.

3.4.1 Domestic Practice and Application Hu Lin et al. [17] sorted and analyzed five years of Web of Science data from 2012-2017, applying bibliometrics and big data algorithms to user portraits, systematically discussing literature from perspectives of country, project funding, publishing institutions,

disciplinary fields, and journal literature years, and deeply studying user portrait characteristics to reveal future research hotspots and development trends. Huang Wenbin et al. [18] selected 500 papers from important domestic and foreign journals and conference proceedings, constructing a research framework for mobile user behavior under data-driven models through literature review and analysis. The framework includes four aspects: mobile data types, mobile user behavior pattern analysis, mobile user portrait model construction, and in-depth application of mobile user portraits. In mobile user portrait construction, they proposed cleaning and mining mobile data to derive frequent activity patterns and location sequence relationships, combining this information with mobile user behavior and mobile user portrait characteristic attributes to accurately predict user behavior and provide personalized services. This research will play an important role in precision marketing, network resource allocation, and urban planning. W. Cui et al. [19] proposed a CP-ABE-based structural encryption method to protect privacy in the context of increasing privacy concerns for mobile social network user portraits. In this system, users must download a program from the Internet to their mobile phones. When the program runs, users generate and create their attribute lists and submit them to the server for permission registration while generating a pair of secret keys. When initiators want to find matching users based on their preferences in airports, hospitals, or special situations, they generate public keys through query lists and send them to nearby users to establish connections, thereby protecting user privacy. This approach provides secure communication channels, effectively prevents eavesdropping attacks, accelerates the matching process, reduces computational and communication costs, and can assist government public opinion management and control.

3.4.2 International Practice and Application J. DeAndrés et al. [20] determined demographic differences based on how users interact with web applications. This research requires developing future systems that adapt online information descriptions to users' specific needs and preferences, thereby improving usability and recommending personalized services for users' special preferences and needs. The study first analyzed 592 participants using multiple regression, treating user preferences and experiences as control variables. Results showed that users can be classified according to age, gender, etc., and that implementing new personalized recommendations based on users' specific preferences and needs can improve information system usability. L. Chen et al. [21] proposed constructing user portraits of life satisfaction (SWL) based on social media language during Facebook status updates. The study first collected and processed Facebook data, used filtering algorithms to eliminate large amounts of invalid data, and applied random forest models to predict the relationship between emotional changes and language features during Facebook status updates. Results showed that emotional scores were higher when mentioning holidays and meals, and lower when discussing mathematics and diseases. By analyzing participants' emotional reactions during Facebook status updates, the study cap-

tured users' psychological and emotional characteristics. This research can be extended to clinical medicine, where doctors can monitor patients' emotions, provide psychological counseling based on emotional changes, and thus deliver better treatment.

4. Limitations and Prospects

User portraits represent one of the main research contents that have recently emerged in library and information science, attracting widespread scholarly attention in recent years. Through qualitative and quantitative analysis of relevant literature on user portraits from CNKI and Web of Science, this paper identifies current limitations and predicts future development trends in China's library and information science field.

From the perspective of research themes, domestic scholars' research on user portraits is currently mainly limited to social Q&A communities, digital libraries, and public opinion dissemination, with relatively weak research on other themes. Regarding model construction, user portrait research has mainly focused on the process, steps, methods, and means of model building, without specific analysis for particular domains. How to optimize existing models is a question worthy of scholars' consideration.

4.1 Broaden Research Themes

User portrait research and application have just emerged and have not yet reached maturity, with research fields still relatively singular. Therefore, user portrait research should closely focus on themes such as virtual academic communities, health communities, open innovation communities, online communities, learning communities, and social network media platforms to conduct in-depth theoretical and applied research.

4.2 Emphasize Behavioral Analysis

User behavior includes user needs behavior, user retrieval behavior, user seeking behavior, and user browsing behavior. Consequently, user portrait service recommendations will differ according to different user behaviors. Therefore, in user behavior research, we should specifically distinguish user behaviors and implement user portrait recommendation services based on specific behavioral content.

4.3 Optimize Research Models

The prerequisite for user portrait model construction is the collection and organization of user data. By collecting extensive data, databases can be established to facilitate user portrait model construction. During information collection, data inevitably includes information unrelated to user characteristic behavior, making it particularly important to clean and filter such data. We should draw

on computer domain knowledge and foreign information filtering systems to establish mapping relationships between user portraits and datasets, filter information data, remove useless data, and optimize user portrait models.

This paper uses visualization tools such as CiteSpace and Vosviewer to conduct visual analysis of publication volume, cited journals, research institutions, research hotspots, and keyword density of user portraits in library and information science at home and abroad. Mind mapping tools are applied to analyze the current status of user portraits, presenting research themes, algorithms and techniques, model construction, and practice and application in knowledge graph form. Research findings show: (1) User portrait research in China's library and information science field is in a high-growth stage, with publication volume showing a clear upward trend, indicating that user portraits will become an important research content in this field and attract widespread scholarly attention. Research journals are relatively concentrated, mainly distributed in core journals such as *Information Science: Theory and Application*, *Library and Information Service*, and *Journal of Academic Libraries*. Research institutions are relatively singular, and inter-institutional cooperation should be strengthened to promote more complete and developed theoretical systems for user portrait research. (2) Domestic research themes on user portraits are relatively singular, and model construction is not yet well-developed. Drawing on development experience from computer science, marketing, and international user portrait research, this paper proposes prospects for domestic library and information science user portrait research: broaden research themes, emphasize behavioral analysis, and optimize research models.

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Zhang Xiaohui: Collection and processing of Chinese literature;
Xu Hailing: Paper writing and revision;
Wu Huijuan: Collection and processing of English literature;
Zhang Haitao: Research proposition and formulation of research ideas.

Note: Figure translations are in progress. See original paper for figures.