Future Research Method of Landscape Design Based on Big Data

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Abstract. Big data has become a very hot topic in the field of urban research and planning, which can contribute to the full scale, refinement, humanization and experience quantification of urban planning, but it is still rarely applied in the field of landscape architecture. Big data is dynamic and objective, so it is suitable for landscape research. This paper constructs a new approach to landscape research based on big data with reference to the PERSONA approach in Internet products. Then, through the literature review, it is found that Volunteered Geographic Information (VGI) is more suitable for small scale site analysis.

Keywords: Big data · Research method · Landscape design · Volunteered Geographic Information

1 Introduction

In the contemporary context of information, digitization and networking, the connotation and form of urban space are undergoing rapid changes. It is becoming increasingly difficult to integrate and create large-scale urban space through traditional urban design method. The field of urban design has gradually expanded from the traditional single spatial level to a complex multi-spatial level, from the former static material space to a dynamic and fast-paced urban complex giant system. Many scholars have recognized that emerging big data has great advantages in terms of collection source, scale and scope, timeliness, and this change has the possibility to promote the development of urban design from quantitative change to qualitative change.

Based on these changes, some Chinese scholars have proposed four generations of urban design: the first generation of traditional urban design before 1920, the second generation of modernist urban design after the industrial revolution, and the third generation of green urban design since 1970. And nowadays, China is gradually entering the fourth generation of urban design, which has the characteristics of full-scale, refined, humanized and empirically quantified. At present, many scholars around the world have used big data to conduct citizen behavior analysis and urban spatial analysis. Big data has become an indispensable tool for urban planners.

The change of urban design method and concept has influenced the development of landscape design. Such keywords as “bottom-up”, “participatory design” and “humanity” have been emphasized gradually in recent years. The landscape architecture no

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longer only emphasizes the aesthetics, designers should also take more attention to make sites more user-friendly. However, through the reading of literature about the big data, it is found that there are few research methods on the micro scale, while most of the articles are studied on the macro scale such as country and region. So, it's difficult for landscape designers to use the big data. Therefore, this paper intends to sort out some methods of data collection, processing and analysis suitable for small-scale sites in the literature, and then form a systematic research method for landscape architecture, in order to help landscape designers understand sites and users better.

2 Traditional Research Method

The traditional landscape survey method, also known as the field work, is one of the most important parts of the landscape design process. It is mainly divided into two parts, one is the site research, and the other is the user research. The former mainly studies the surrounding conditions of the site, such as accessibility and passenger flow volume. The latter mainly studies the user needs. Landscape designers use the method of questionnaire survey or random interview to understand users' thoughts. If conditions permit, a focus group will be set up to express their needs.

However, as mentioned in many studies, this traditional research method is defective [1–3]. Firstly, the data obtained from the traditional research method is static, but the use of the site changes over time, so the traditional way cannot help designers understand the dynamic use of the site. Secondly, field research requires a lot of time and money, but the number of samples collected is very limited. Finally, the traditional research method is very subjective, so the feasibility of data is highly dependent on the way of investigation.

There are still advantages in the traditional landscape research method. Firstly, the data obtained from the traditional way is highly accurate for it doesn't depend on the accuracy of the device. Then, the data is more representative than the big data, because the traditional way take into account some people who seldom use the Internet and mobile devices, such as the elderly and children. Thirdly, data collection, processing, and analysis here is pretty easy, so there is no high data analysis requirement for landscape designers. Finally, thanks to direct contact with users, their evaluation and needs for the site can be better understood.

3 Method Generation

The new landscape research method mainly adopts the method of data analysis. Compared with the traditional field work, the new method can optimize some data obtained through inappropriate and limited statistical methods, such as passenger flow volume. With the help of big data, the result of the landscape research method can be more dynamic, objective and comprehensive. Therefore, the new method can help landscape designers understand users and sites better.

The specific step is similar to the traditional research method and is divided into two parts: site analysis and user segmentation. Since the traditional survey method is to

communicate with site users directly, while the new method is based on data collection, processing and analysis. There is no part of direct contact and communication with users in this step, so this step needs a new method to support.

At present, due to the popularity of the Internet and mobile devices, Internet products have prospered and formed a more systematic user analysis method based on the background of big data, called PERSONA. The specific steps are as follows:

Step 1: Identify the overall map of the costumers;
Step 2: Detailed the target population, conducted in-depth analysis of the target population, excavated the core needs, and drew a complete portrait;
Step 3: The brand usually has more than one segment of the group, for each crowd design customized marketing plan [4].

According to the above steps, it can be seen that the PERSONA is a process of gradually refining the user classification. Through careful user classification, differentiated services can be provided to the users. Currently, PERSONA has been widely applied in personalized recommendation and advertising (Fig. 1).

Based on the actual needs of landscape research and user classification method of PERSONA, the following steps are drawn:

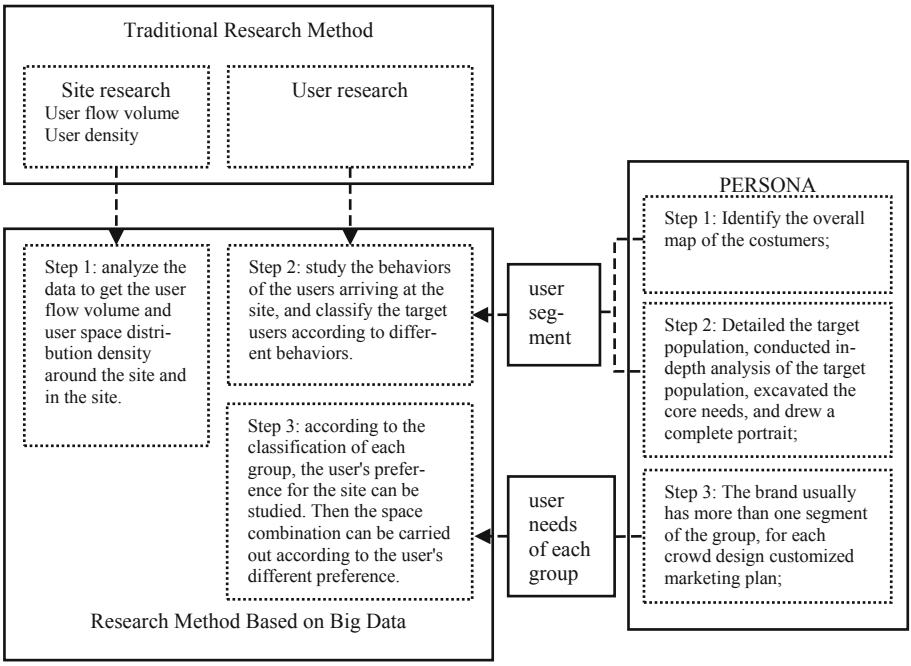

Fig. 1. The generation of Research Method of Landscape Design Based on Big Data

4 Interpretation

The specific steps of landscape research method based on big data are as follows:

Step 1: analyze the data to get the user flow volume and user space distribution density around the site and in the site.
Step 2: study the behaviors of the users arriving at the site, and classify the target users according to different behaviors.
Step 3: according to the classification of each group, the user's preference for the site can be studied. Then the space combination can be carried out according to the user's different preference.

In the following paragraphs, each step is described in detail. At the same time, this paper will illustrate how to select data for each step with literature research.

4.1 Step 1: Analyze the Data to Get the User Flow Volume and User Space Distribution Density Around the Site and in the Site

The data analysis of step 1 is mainly for the research of the site. Since the people around the site are likely to go to the site, the research scope is not only limited to the site, but also the surrounding of the site. As mentioned above, both passenger flow volume and user spatial density distribution are dynamic data. The former lays more emphasis on time dynamics, while the latter lays more emphasis on space dynamics. Both of them can help designers reasonably configure service facilities.

Although the purposes of many studies are inconsistent, many scholars have applied various data to study the spatial and temporal variations of sites (Table 1).

Table 1. The application of big data to study the spatial and temporal variations of sites.

Data type	Author	Data sources	Research method
GPS	Wang, X. et al.	Amap	The customer flow of the site in different time periods is calculated by an application called Amap Index developed by Amap company [5]
GPS	Chen, Y. et al.	The hourly real-time Tencent user density (RTUD)	The RTUD data from social media is used to analyze the time-spatial distribution of urban park users [2]
Smart card data	Li, F. et al.	Smart card data in Beijing	Spatially visualize the bus station distribution information and the bus swipe secondary data, and then combine the land use status to obtain the destination attributes of the residents, and determine the frequency of each land use [6]

(*continued*)

Table 1. (*continued*)

Data type	Author	Data sources	Research method
Volunteered geographic information (VGI)	Sun, Y. et al.	Geotagged photos from Flickr	Use Flickr photos as an example to explore the possibilities of VGI to analyze spatiotemporal patterns of tourists' accommodation in Vienna [7]
VGI	Zhang, Z. et al.	LBS sign-in data of Weibo	This paper takes Sina Weibo as the research object, introduces LBS sign-in data, and uses the "horizontal" and "longitudinal" time stratification method to empirically study the spatio-temporal evolution characteristics of tourists inside Nanjing Zhongshan Scenic Spot by dividing gender and regional attributes [8]
Wi-Fi	Huang, W.	Indoor positioning system	Wi-Fi location devices are installed in major scenic spots of huangshan scenic area to obtain mobile phone location data. After processing, the spatial-temporal trajectory data of tourists are formed to analyze the spatial-temporal distribution of tourist behaviors [9]
Others	Li, Y. et al.	Google street view images	Use City of Buffalo as a case study area to explore extracting pedestrian count data based on Google Street View images using machine vision and learning technology [10]

Most studies of this step use GPS for data analysis. GPS is suitable for large-scale urban space due to the huge and real-time data, so it is widely used in urban research [1]. However, GPS has some disadvantages, such as the inability to obtain personal attributes and accuracy problems, so it is more suitable for analyzing the overall situation of users rather than classifying users.

4.2 Step 2: Study the Behaviors of the Users Arriving at the Site, and Classify the Target Users According to Different Behaviors

4.3 Step 3: According to the Classification of Each Group, the User's Preference for the Site Can Be Studied. Then the Space Combination Can Be Carried Out According to the User's Different Preference

Since most of the literature classifies users for the purpose of studying the preferences of different groups, the step 2 and step 3 are inseparable. So, this section combines the two steps.

Firstly, the user classification method of traditional landscape research is mainly based on the basic attributes of the population (gender and age). Secondly, due to the limited information of some data, it cannot reflect the differences between the users or describe the behavioral characteristics of users. Therefore, in most literature, the classification of users is based on basic attributes (Table 2). However, this way of classifying users can only obtain the differences in behaviors and preferences caused by gender gap or cultural custom gap, which is imprecise.

Table 2. The application of big data to classify users.

Data type	Author	Data sources	Research method
VGI	Vu, H. et al.	Geotagged photos from Flickr	By extracting the geographic information in the photos, the differences in travel preferences between Asian tourists and western tourists were compared [12]
VGI + Mobile phone data	Girardin, F. et al.	Geotagged photos from Flickr	By collecting geotagged photos made public on Flickr, and the number of users making calls from mobile phones on the TIM system, we found inconsistencies in user behavior across different regions of Rome [13]
Mobile phone data	Tian, B. et al.	Mobile phone data from Shanghai	Through the analysis of mobile phone data, local residents and nonlocal tourists are identified. And then calculate the proportion of residents and nonlocal tourists visiting different blocks [14]
VGI	Abbasi, A. et al.	Twitter	By extracting the word frequency of tweets posted by users, the activity purpose of tourists can be identified [11]

Social network big data contains a large amount of Spatial and Temporal information, semantic information, emotional information, correlation information, etc., and its analysis and mining can help us to know users in many aspects. For example, when studying the behavioral characteristics of Sydney tourists, Abbasi, A. et al. extracted the tweets posted by users on Twitter, and then filtered out the higher-frequency words in tweets for clustering to identify the purpose of the tourists [11].

In the past, the evaluation of planning and design was mainly based on the subjective feelings of a few experts or users. But now big data can realize the flexible interaction between landscape designers and users. For example, the designer can obtain the text information published by the user and the spatial information when the user publishes the text through the data of the social platform, in order to collect the user's psychological feelings or cognition of the space and other information, and judge whether the landscape planning can meet the needs of users. Timely discovery of site problems is conducive to design improvement. Some scholars have used big data to analyze users' preferences and evaluations (Table 3).

And with the emergence of some specialized and niche mobile applications, it is possible to study the behavior patterns of a specific group of people. Sports social media, for example, has boomed in the last five years, showing runners' jogging routes. This superimposed map of running routes helps to study the behavior and preferences of runners and provides a reference for the planning of jogging paths (Table 4).

Table 3. The application of big data to analyze users' preferences and evaluations.

Data type	Author	Data sources	Research method
VGI	Wang, X. et al.	Dianping.com	Through word frequency analysis of the site evaluation on dianping.com, the user evaluation is obtained [5]
Web search terms	Zhang, Y. et al.	Search words frequency of Baidu, Google, Mafengwo.com, TripAvisor	Through the research on the search word frequency of different websites, to analyze the interest of tourists, and compare the differences of tourists' interest in scenic spots at home and abroad [15]

Table 4. The application of big data to study the behavior patterns of a specific group.

Data type	Author	Data sources	Research method
VGI	Oksanen J. et al.	Sports tracking	Get movement data from the mobile motion tracking app and generate a heat map of the ride [16]

4.4 Conclusion

In this paper, a new approach of landscape research is formed based on the needs of landscape research and PERSONA. Then combine the literature reading to carry on the concrete explanation to each step.

In the process of literature reading, it can be found that most of the current user classification is based on the user's basic attributes. This classification method cannot help the landscape designers to understand the difference of user behavior, and has low reference value in the design process.

Moreover, in the process of the planner using big data to study the city, SCD, floating car (taxi)GPS data and MPD are frequently used in the research process due to the need of large samples with relatively universal significance [1]. However, according to the literature, it is found that VGI is more suitable for use in small-scale sites, because it can realize refinement of individual attribute data and well applied to facilities site selection and evaluation [1]. In addition, with the development of some niche software, the specific behaviors and preferences of some groups can be

understood through the analysis of the text, pictures, location and other information submitted by users in these applications.

The advantage of the new landscape research method compared with the traditional one is that the data is more objective and huger. And because of the real-time data, it can realize the interaction between the landscape designers and the users.

5 Discussion

Big data has become a very hot topic in the field of urban research and planning practice, but some scholars have "cold thought" about big data, thinking that big data may cause some errors and errors due to its inauthentic data collection, representativeness problems, consistency and reliability problems. And also big data may cause ethical issues [17]. So as some scholars believe, big data is only a tool to assist the arrangement and expansion of ideas, which cannot completely replace the design steps, and the role of big data should be viewed rationally [18].

Secondly, although this paper focuses more on the role of big data, the traditional research method can clearly know the specific behavior of users and the specific feeling of using space, which is not available in the research method described in this paper. Therefore, the future research method can be combined with the traditional design research method, which is more helpful for landscape designers to have a deeper and comprehensive understanding of site users.

The method in this paper is not only helpful to the process of landscape research, but also to the process of site maintenance and management. Because of the dynamic of big data, designers can make timely adjustments to the site according to the real-time site use data.

Finally, this method is still not widely used in landscape design field. One reason is that big data is controlled by many Internet companies, and the data is limited to acquire. And secondly, because the concept of big data is gradually emerging, landscape designers have not yet met the expectations of big data analysis and application skills. So, it is difficult to try to apply big data in the landscape planning and design research. Therefore, the application of big data in landscape design still needs efforts and support from all aspects.

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