City Street Scent Landscape Drawing

Digital Media Representation Art for Olfactory Perception

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Abstract. The street is the most intuitive space for people to perceive the city, and street odor is also an important way to measure the quality of street space. Nevertheless, due to insufficient means of quantitative odor analysis, the urban odor landscape has not yet attracted sufficient attention from the urban research community. This article attempts to use big data search and information retrieval technology, combine the street odor tracking experiment with the semantic analysis of social media data, classify the typical street odors in Shanghai, analyze the odor distribution characteristics of typical characteristic streets, use GIS geographic information system, adopt the multidisciplinary technical means to draw the odor map of typical characteristic streets, and verify the reliability of the odor landscape map by social data and its semantic analysis. The reliability of the odor landscape map is verified by social data and semantic analysis. On the basis of the results, we analyze the influence of street odor levels and odor landscape on the characteristics of the streets, focusing on Wukang Road. Finally, we discuss the potential application of odorscape research in urban environment design in the context of the research results.

Keywords: Urban Street · Odor Tracking · Odor Landscape · Big Data Search · Urban Environment Design

1 Introduction

According to a British insurance company's 2008 recommendations for claims related to sensory loss, compensation for total loss of smell is £14,500–19,100, for total loss of hearing is £52,950–£63,625, and for total loss of vision is £155,250. This valuation seems interesting, as the mainstream Western science ranks the sense of smell on the periphery of the five human senses, and Kant considers the olfactory organ as "the most costly and redundant sense" [4]. However, it is a fact that the olfactory organ is the first sense to appear during fetal development, while the other sensory systems develop later. It is reasonable to assume that the first experiences of the child's sensual life begin in the field of smell, and that our life begins with the smell of a "life scent" emanating from the fluid in the womb. This primitive and ancient process of sensory formation predestines this sense of smell to be a very uncomplicated one [3].

The profound relationship between memory and smell should come as no surprise to anyone. The ability of an odor to evoke nostalgic memories is unlike any other sensory

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memory. The unique nature of this phenomenon is informally known as the "Proust Effect". Christina Zelano from Northwestern University Feinberg School of Medicine [2] said that at some point in our ancient history, as our brains evolved, all other neurosensory pathways were reorganized through different areas of the brain. But for some reason, our olfactory system retained a direct connection to the hippocampus.

The fresh smell of a park is comforting and relaxing, while the smell wafting out of a public restroom is always a source of tension. For the memory of a city, many people will retain the smell of scenes unique to their childhood. Smell connects our deepest memories of the city, and smell makes our impression of the city deep and full. This study hopes to explore the visual image method of odor recording expression from the review of domestic and foreign research, so that more researchers can pay attention to the odor characteristics of cities, the connection between urban memory and odor, and thus to break the pure visual city image and build a multi-sensory three-dimensional city impression.

2 Review of Research

2.1 Status of Foreign Research on Smell Landscape

Foreign scholars have realized the importance of urban odor earlier. They have conducted a large amount of basic data collection and adopted various experimental methods, including the use of odor analyzers to directly extract air samples for odor analysis, identification and measurement; there are also volunteers organized to conduct odor walking experiments to transform the sensory experience of odor into visual color experience and mark it on the map; there are also experts related to the psychological study of odor experiments. Victoria Henshaw, a British scholar, has been conducting research on the psychology of odor experiments. In her book Urban Smellscapes [7], Victoria Henshaw explores the relationship between odors and urban smellscapes and describes the importance of odors in creating a sense of place and how to design urban smellscapes. Another iconic olfactory artist, Sissel Tolaas, established the ReSearch Lab in Berlin, a laboratory dedicated to the study of smells, and has used over 6,500 smells to build a smell map of 52 cities [6]. Kate Mclean, a New York-based artist, defined different smells in color and led volunteers to conduct scent walking experiments in different cities such as New York, Barcelona, and Singapore to create an olfactory sensory map [5].

2.2 Status of Domestic Research on Smell Landscape

Ancient artists in China have rich and profound discussions on aesthetic senses such As sight, hearing, taste and smell. China's traditional incense science, which has been dense for thousands of years, is precisely the ultimate embodiment of the literati's pursuit of olfactory aesthetics. Qian Qianyi, a literary scholar in the late Ming and early Qing dynasties, proposed the sense of smell as the main sense of aesthetic appreciation.

Feng Rongfrom Tsinghua University described and mapped the scent landscape of Beijing's Houhai as a whole and in key areas, and explored the ideas and methods of

scent-led urban design based on this. [1] The research scale of Feng Rong's team takes the urban area as the basic research scale with a larger scope. The scale of this study is mainly focused on the small scale of streets, and we try to explore the odor characteristics of different streets in a more detailed way.

3 Steps of GIS-Based Odor Landscape Mapping

3.1 Feasibility Based on GIS

This study attempts to integrate the data of interest points and subjective emotional and psychological feelings based on the basic database of GIS, to integrate and express the information on the spatial map, and to extend the dimension of map information. The spatial data and attribute data in GIS database are closely related to each other, and the consistency of the data is required to be high. With the understanding of spatial information science and GIS application, the definition of spatial objects and their data structure have become more consistent, so that the spatial data model of different GIS software does not differ much in the concept and logic model level, which provides the possibility of sharing GIS data from different sources. At present, all large and medium-sized cities in China have detailed GIS data resources, and it is feasible to use this as the foundation platform for research.

3.2 Data Sources

The study of street odor in Shanghai incorporates odor into the street space system at the human perception scale. The research data mainly includes the basic roads, the public review data, and the map POI data. (1) The selection of basic roads is based on the streets represented by historical districts, as well as living streets, and there are nine representative streets and neighborhoods in this study. They are Qibao Ancient Town, Yuyuan Road, Hengshan Road, Huaihai Middle Road, University Road, Duolun Road, Wukang Road, Yunnan South Road, and Julu Road. (2) Public review data: Considering that odors are related to people's subjective perceptions, the correlation between the types of urban odors and people's preferences was determined by semantic analysis (4843 items of public review data) (Fig. 1), and the general population's odor preferences for streets were determined by analyzing the odor pointers in language and the odor preferences. (3) Map POI data, based on typical streets, selected data points related to urban odors on both sides of the street, totaling 5981.

3.3 Odor Classification

The odor classification (Table 1) in this study was borrowed from the odor classification method used by the Tsinghua University team during the experiment in Beijing. There are 9 major categories of odor classification, including: food, natural odor, domestic emission odor, urban construction, animal, medicine, artificial odor, and others.

Table 1. Odor classification and corresponding POI data types.

Odor classification	POI data point type
Food	Coffee store, western food store, milk tea store, special snack store
Natural environment	Street pocket park, tree pond, flower bed, flower store
Domestic emissions	Sewers, public restrooms, car exhaust, repair stores, refuse collection points
Urban construction	Construction sites, renovation sites
Animal odors	Pets, pet stores
Medical odor	Pharmacies, Chinese medicine stores, hospitals, etc.
Artificial odors	Shopping malls, boutiques, hotels, etc.
Other odors	Woodworking workshops, leather goods stores, etc.

3.4 Methodology of Odor Landscape Map Production

For the odor study of typical streets, odor field tracking research was conducted in two groups to gain an in-depth understanding of the odor characteristics and the basic composition of typical streets in Shanghai from a microscopic scale, so as to form a prospect for application in subsequent urban characterization studies. According to the researchers' perceptions, the street odors were stratified and categorized as follows: (1) Overall odor impressions, which are basic odors. It is a background type of odor that exists relatively stable for a longer period of time within a certain spatial area. For example, the smell of the river, the smell of the asphalt road, the smell of wet air after rain, etc. (2) Fixed odor. It is a representative odor emitting point on the street. These odors can reflect the distinctive characteristics of the street. For example, the smell of western food and butter, the smell of wood from bookstores, the smell of moxa smoke from moxa stores etc. (3) Random odors. This type of odor refers to those odors that are generated by chance in the place and exist for a short time. For example, the smell of coffee on the hands of a passerby, the smell of body wash on a passing golden retriever, the smell of cigarettes, etc.

The research team used an online method to recruit olfactory experimenters, distributed research charts on site, and conducted a 15-min training session on site. The research was conducted from 1.22 to 1.26. The field research was completed in two groups, and three types of odors were recorded, as well as the intensity, persistence, preference, and subjective sensory association of each odor. Then the experimenter made color association matching according to the subjective feelings and matched the colors for the corresponding odors.

Various emotional colors and emotional tendencies in the public reviews, such as joy, anger, sadness, happiness, criticism, and praise, are also used to analyze the emotional tendencies of the evaluators through natural semantic analysis. Then the qualitative data is quantified by sentiment score to visualize and analyze the human sentiment value linkage space. Finally, it is overlaid with the odor distribution map to analyze the relationship between odor and pedestrian emotion. In order to make the positive

and negative emotion analysis accurate, the data extracted from the public reviews were first organized, and then the high-frequency words of the reviews as well as the web semantics were analyzed with the help of NLPIR big data emotion processing system. The emotional polarity of the text was judged to be negative at -6-0, positive between 0 and 6. 0 was neutral, and finally the evaluation emotional values were divided into three categories to further analyze the typical street subjective feelings of people's emotions.

4 Streets Odor Landscape Drawing

4.1 Street Odor Landscape Drawing

Wukang Road was built in 1907, according to "Shanghai Xuhui District Geographical Names", "The road was originally named Fu Kaisen Road, named after the American Fu Kaisen's surname. 1943 changed the current name to Wukang Road, named after the old county name of Zhejiang Province." Wukang Road is 1183 M long and 12 M–16 M wide. The whole road runs roughly north-south, starting from Huashan Road in the north, where the lilac garden of Li Hongzhang, an important minister of the late Qing Dynasty, is visible, to Huaihai Middle Road in the south, where it connects Tianping Road and Yuqing Road, and looks at the former residence of Song Qingling. Wukang Road, with its lush wutong trees, has a high "density" of celebrity residences, with about 30 of them. Along the Spanish, French Renaissance and other styles of architecture is rich in features, is one of the most European-style neighborhoods in central Shanghai.

Firstly, a field odor research approach was launched on Wukang Road. A total of 8 odor experimenters identified different odors and recorded the odor characteristics, intensity, duration, and preference, etc., and dropped them on the odor map. Referring to McLean's odor tracking approach, Wukang Road odor mapping paid more attention to the interaction between human emotions and odor perception.

Through field research on Wukang Road, the odor experimenter found that the odor types of Wukang Road showed diverse characteristics and most of them were comfortable and pleasant odors. According to the feelings of field research, the persistence, intensity, preference, and description of feelings of odors were recorded (Figs. 1, 2 and 3). The base odor of Wukang Road street is a relatively moist post-rainy odor. Because it is a famous historical district, there are also many old trees with a long history on the street, which are wrapped with dark green moss and have a natural fresh odor. There are also Japanese coffee shops, Petts coffee shops, and Starbucks, and the aroma of coffee and bread is one of the more relaxing and characteristic smells of the street. There are also some small and delicate fashion stores, jewelry stores, and flower stores, which also have a fresh and elegant aroma. Of course, there are also pedestrians rushing through the streets, and the scent of pet shampoo from the large golden retriever is mixed in the background scent of the streets. There were a few places on the road where there was the artificial smell of detergent cleaning the street.

At the end of the street, there is a small pocket park with the smell of pine trees, next to a Starbucks coffee shop, and the strong coffee scent mixed with the grass and trees of the park gives a very relaxing feeling. There is also a bicycle repair store on the side of the street, which still smells a little like motor oil, giving a slightly uncomfortable feeling.

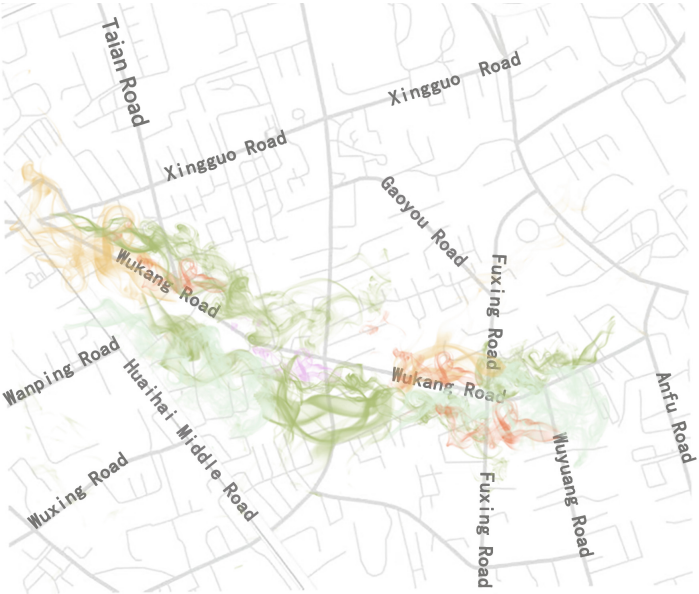

Fig. 1. Preferred odor distribution

Fig. 2. Disliked odor distribution

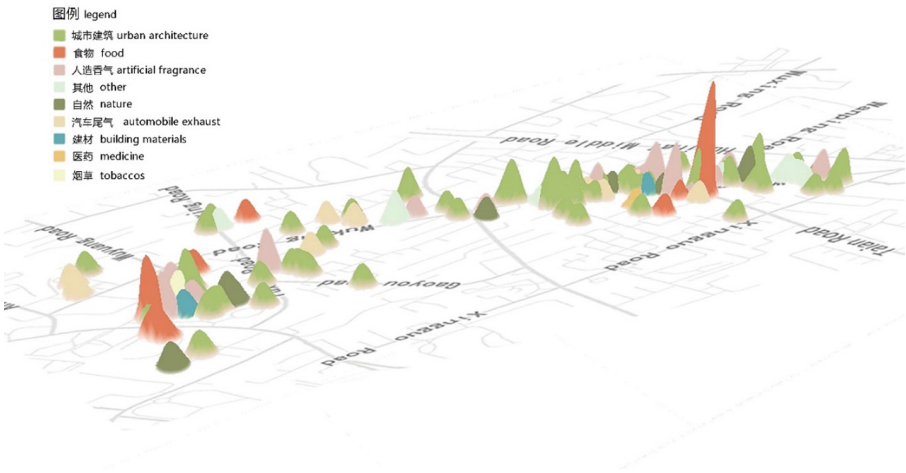

Fig. 3. Distribution of odor concentration in Wukang Road

Then we use the street POI data to sort out the scent classification, classify the scent in categories, and filter out the favorite scents such as: food, nature, etc. These odors constitute the main odor impression of the street, and are also the reflection of the vitality and characteristics of the street. In addition, we sorted the odor categories and filtered out the objectionable odors such as sewer odor and garbage removal point odor. These odors are factors that affect the quality of the street space, because the bad experience feeling often reduces the possibility of pedestrians staying here and reduces the activity interaction in the space. The spatial overlay of these two types of odors is the overall odor distribution map of Wukang Road street (Fig. 4).

A comprehensive analysis of the odor characteristics of Wukang Road reveals an important reason for its popularity: Wukang Road has a lot of historical and cultural heritage, so the whole street is not commercially developed on a large scale, the whole street is less noisy than a big city, temporarily free from the bad odor of the city, and the overall street odor gives people the impression of clean and happy.

4.2 Sentiment Analysis Validation

The data from VWAP was analyzed for semantic sentiment, and it was found that the areas with higher ratings for the whole street were mainly concentrated in stores such as Starbucks, Xiaozhi, and petts. There are few stores with lower ratings, and the overall network ratings are relatively good experiences and impressions for the rating value of Wukang Road. Overlaying the bubble map of odor distribution with the map of emotion distribution (Fig. 5), we can see that places with higher positive emotion mainly emit fragrant and mild food scent, and the live intensity of these locations is also higher. Whereas places with more vehicles at intersections, etc., there are some negative evaluations with low emotions. The superimposition of the odor concentration map with the mood map can be analyzed to see that the comfortable and pleasant, the space where pedestrians

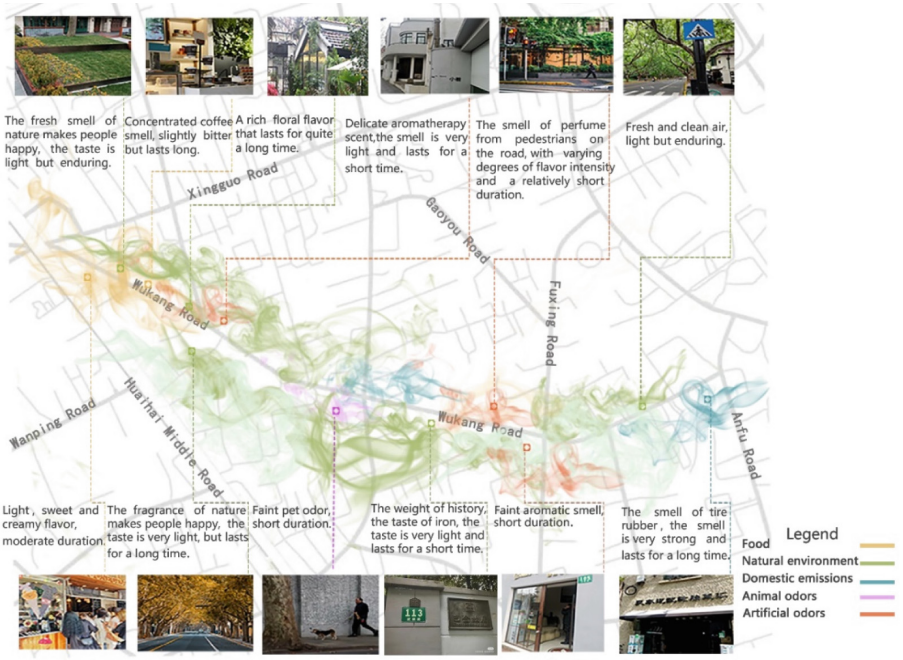

Fig. 4. Wukang Road odor distribution

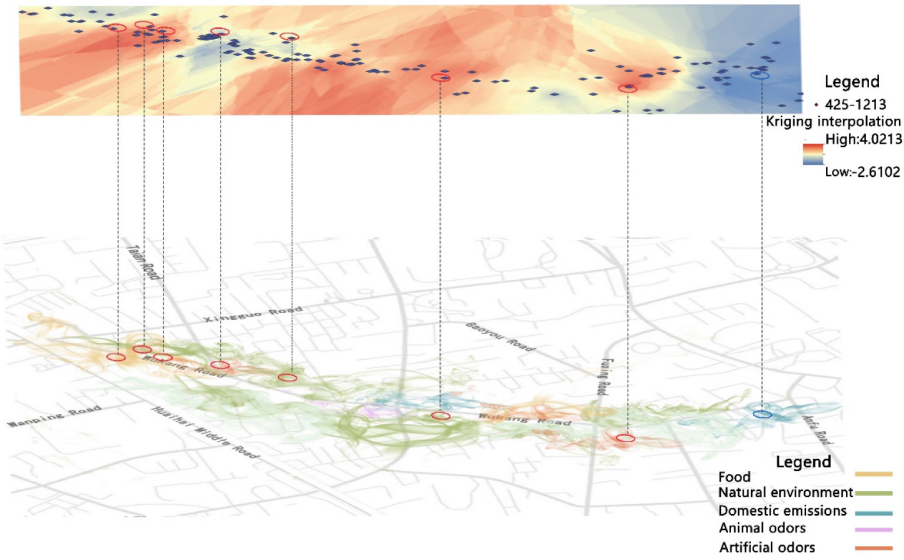

Fig. 5. Superposition analysis of smell distribution map and emotion distribution map

are willing to stay and stop, is usually a quieter, fresher and more comfortable smelling lot.

5 Conclusion

The study of Shanghai typical street odor mapping is an exploratory study that synthesizes domestic and international research cases and combines the characteristics of Shanghai characteristic streets themselves. Using the data of public reviews, POI data, etc. to identify the odors of typical streets in Shanghai, a comprehensive judgment of emotional value is made, and the bubble map of odor feature distribution is drawn to analyze the spatial distribution of preferred odors and repulsive odors. And combined with the on-site empirical research, the typical street with characteristics of Wukang Road was selected for on-site research, detailed odor record analysis was conducted, and the odor map was drawn to make a comprehensive judgment with the emotional value distribution of the location, verifying the odor characteristics and preference characteristics of the location, and outlining the odor map of Wukang Road with its own characteristics. It also provides a new conservation idea for Wukang Road to further enhance the vitality of the street and continue the street culture.

By sensing and understanding the odor classification of the city, constructing an odor map of the characteristic streets, proposing solutions for negative odors, and constructing guidance solutions for positive odors, it has new and far-reaching significance for the creation of characteristic street environment design.

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