

The sensorial map of the city

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Extended Abstract

Our daily urban experiences are the product of our perceptions and senses [7], yet the complete sensorial range is strikingly absent from urban studies. Sight has been historically privileged over the other senses and urban studies often focused on the visual dimension of cities [4, 3]. However, smell and sound have a huge influence over how we perceive places, they impact our behavior, attitudes and health. Yet, city planning is concerned only with a few bad smells and with limiting noise levels.

Not knowing what smells and sounds exist in cities may result in partial views of the collective image of our urban areas, the proliferation of clone towns (as smell and sound contribute to the city's identity [1, 9]), and in reinforcing socio-economic boundaries, as smell and sound that provide insights into the social life of cities are used (often unconsciously) as invisible markers between neighborhoods with different socio-economic status [5].

In our work we propose a new way of capturing nuanced olfactory and auditive perceptions of cities from data implicitly generated by social media users.

The idea is to search for smell and sound-related words on social media content. To this end, we first build two dictionaries of smell and sound-related words. We ventured out in the urban world and conducted “smellwalks” in a variety of cities: participants were exposed to a range of different smellscape and asked to record their experiences. As a result, smell-related words have been collected, classified, and enriched with words available from previous studies on smell [2], thus creating the first dictionary for urban smell¹. Similarly, to obtain a sound-related dictionary, we collected sound-related words from previous literature on sound and from crowd-sourced online data².

For both Barcelona and London, we collect geo-referenced picture tags from Flickr and Instagram, and geo-referenced tweets from Twitter. We match those tags and tweets with the words in the smell and sound dictionaries. To create a structure for a large and apparently unrelated dataset of words, we cluster the co-occurrence

network where nodes are smell/sound words and undirected edges are weighted with the number of times the two words co-occur in the same pictures as tags. Emerging clusters show that smell and sound-related words are best classified in ten and eight macro-categories, respectively.

Placing those smells and sounds on a map allows for a powerful cross-dimensional exploration of the urban space that yields a series of interesting results [8] we summarize as follows.

Air quality indicators correlate with specific smell categories.

The olfactory experience of a city is inevitably influenced also by the quality of the air, measured by the amount of pollutants (*CO*, *NO₂*, *PM₁₀*, *PM_{2.5}*) that are emitted in the atmosphere by several human activities and that pose potential harm to human and environmental health. These chemicals may or may not be detected through the human senses [6] but some of them have odors. We find that specific smell categories (e.g., industry, transport, cleaning) strongly correlate with governmental air quality indicators.

Noise pollution levels correlate with specific sound categories.

Excessive urban noise can cause serious hazard to the residents' health. For this reason, city officials measure or estimate the noise levels at street-level and often those estimates are available to the public. We find that specific sound categories (e.g., mechanical sounds) strongly correlate with noise levels recorded at street-level.

Cities have a unique smell and sound profiles that fluctuates in time.

By analyzing the distribution of smells and sounds in space and time, we can pinpoint the best locations and times to perceive them. In particular we find that cities have a distinctive smell footprint that is layered on a scale of smell “notes”, ranging from the most pervasive and persistent to the most rare and ephemeral. We also find that some of those notes are more predictable than others during the yearly cycle.

Smell pleasantness correlates with the sentiment expressed by city dwellers.

Based on the literature [2], we are able to know what are the smells people like and those they dislike. We derive a pleasantness score out of those words. We find that locations with pleasant smells tend to be associated with geo-referenced tags conveying positive emotion recorded in the same areas, while locations with unpleasant smells tend to be associated with negative emotion tags.

Smells have distinctive colors. In addition to emotion-related tags, one could study color-related tags as they make it possible to explore the relationship between smellscape and colors (e.g., what is the color of urban nature?). The study of such a relationship might result in several practical implications from map visualization to multi-sensory virtual reality experiences. By studying co-occurrences of smells with color tags (taken from a list of 250 nuances) we find clear pairings of smells and colors (e.g., nature smells are associated with green, violet and orange, food smells

¹The dictionary is made available at researchswinger.org/smellymaps

²www.freesound.org

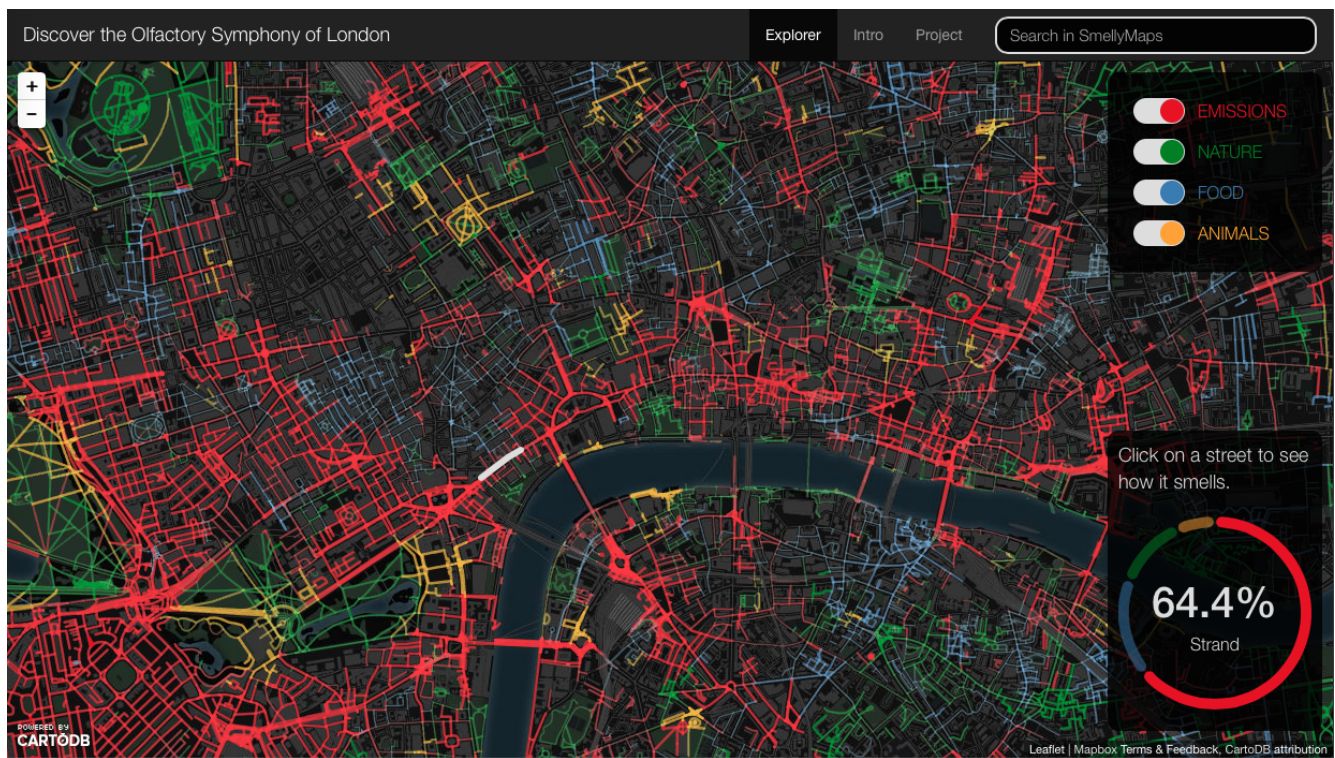


Figure 1: Map of the olfactory symphony of London

with brown and orange, traffic smells with gray and black).

Visualizing senses and emotions on maps. Our work opens interesting directions in the field of visualizations and storytelling on maps using the crowdsourced urban perceptions. We explored new paradigms to visualize sensory data by means of digital mapping tools that transform the web into a dynamic platform for urban participatory sensing. We developed an interactive map (Figure 1) to discover the olfactory symphony of London that has been showcased at the month-long Measure³ exhibition at the Storefront for Art and Architecture⁴ in New York.

With our work, we hope to contribute to the growing body of literature on how people sensually experience the city and to empower designers, researchers, city managers by offering them a number of methodological tools and practical insights to re-think the role of smell in their work.

1. REFERENCES

- [1] J. Drobnick. 2006. *The Smell Culture Reader*. Bloomsbury Academic.
- [2] Victoria Henshaw. 2013. *Urban Smellscapes: Understanding and Designing City Smell Environments*. Routledge.
- [3] J. Jacobs. 1961. *The Death and Life of Great American Cities*. Random House.
- [4] K. Lynch. 1960. *The Image of the City*. Mit Press.
- [5] Laura Macdonald, Steven Cummins, and Sally Macintyre. 2007. Neighbourhood fast food environment and area deprivation—substitution or concentration? *Appetite* 49, 1 (2007).
- [6] C.M. McGinley, T.D. Mahin, and R.J. Pope. 2000. Elements of Successful Odor/Odour Laws. In *WEF Odor/VOC 2000 Specialty Conference*.
- [7] Daniele Quercia, Rossano Schifanella, and Luca Maria Aiello. 2014. The Shortest Path to Happiness: Recommending Beautiful, Quiet, and Happy Routes in the City. In *Proceedings of ACM HT*.
- [8] Daniele Quercia, Rossano Schifanella, Luca Maria Aiello, and Kate McLean. 2015. Smelly Maps: The Digital Life of Urban Smellscapes. In *ICWSM'15: Proceedings of the 9th AAAI International Conference on Weblogs and Social Media*. AAAI.
- [9] R. Reynolds. 2009. *On Guerrilla Gardening: A Handbook for Gardening Without Boundaries*. Bloomsbury Publishing.

³<http://storefrontnews.org/programming/measure/>

⁴<http://storefrontnews.org/>