Proceedings of Meetings on Acoustics

Beyond the noise: open source soundscapes. A mixed methodology to analyse, evaluate and plan "everyday" quiet areas.

--Manuscript Draft--

Manuscript Number:	
Full Title:	Beyond the noise: open source soundscapes. A mixed methodology to analyse, evaluate and plan "everyday" quiet areas.
Article Type:	ASA Meeting Paper
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Abstract:	Today, cities have become increasingly noisier. In Europe, over 125 million people are affected by noise pollution from traffic every year, and apparently, quietness is becoming a luxury available only for the elites. There is a growing interest in protecting and planning quiet areas, which has been recognized as a valid tool to reduce noise pollution. However, developing a common methodology to define and plan quiet areas in cities is still challenging. The "Beyond the Noise: Open Source Soundscapes" project aims to fill this gap of knowledge by applying the soundscape approach, the citizen science paradigm and open source technology, with the ultimate goal of making quietness as a commons. Accordingly, a new mixed methodology to analyse and plan small, quiet areas on the local scale has been tested through the development of a pilot study in a Berlin neighborhood affected by environmental injustice and noise pollution. In this pilot study, a number of citizens have been involved in crowdsourcing data related to "everyday quiet areas" by using novel mobile technologies. This contribution illustrates the project's theoretical background, the methods applied, the first findings of the study and its potential impact.
Section/Category:	Noise

Proceedings of Meetings on Acoustics

Volume 30 http://acousticalsociety.org/

173th Meeting of the Acoustical Society of America

Boston, Massachusetts
24-30 June 2017

2pNSa: Paper 2pNSa8

Beyond the noise: open source soundscapes.

A mixed methodology to analyse, evaluate and plan “everyday” quiet areas.

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Today, cities have become increasingly noisier. In Europe, over 125 million people are affected by noise pollution from traffic every year, and apparently, quietness is becoming a luxury available only for the elites. There is a growing interest in protecting and planning quiet areas, which has been recognized as a valid tool to reduce noise pollution. However, developing a common methodology to define and plan quiet areas in cities is still challenging. The “Beyond the Noise: Open Source Soundscapes” project aims to fill this gap of knowledge by applying the soundscape approach, the citizen science paradigm and open source technology, with the ultimate goal of making quietness as a commons. Accordingly, a new mixed methodology to analyse and plan small, quiet areas on the local scale has been tested through the development of a pilot study in a Berlin neighborhood affected by environmental injustice and noise pollution. In this pilot study, a number of citizens have been involved in crowdsourcing data related to “everyday quiet areas” by using novel mobile technologies. This contribution illustrates the project’s theoretical background, the methods applied, the first findings of the study and its potential impact.

1. NOISE POLLUTION AND THE ISSUE OF "QUIET AREAS" IN EUROPE

According to the World Health Organization (WHO 2011), noise from road traffic constitutes the second most harmful environmental stressor in Europe, behind air pollution, affecting over 125 million people every year (EEA 2014). The detrimental effects of noise arise mainly from the stress reaction it causes in the human body, which can potentially lead to premature death, cardiovascular disease, cognitive impairment, sleep disturbance, hypertension and annoyance (EEA 2017).

To take action against noise pollution is therefore imperative.

At the European policy level, in 2002 the European Environmental Noise Directive 2002/49/EC [refereed to hereafter as the "END"] was adopted with the aim of establishing a common approach to avoid, prevent, and reduce noise pollution among the Member States. The END provides a quantitative methodology based upon:

- "noise indicators" to calculate and describe noise pollution from traffic by means of a physical scale and sound pressure levels (e.g. "L_{den}: which is the standard to express noise level over an entire day; whereas L_{night} is aimed to calculate noise level at night);
- "noise maps" to represent noise pollution and inform the public about it and the related harmful effects;
- "action plans" - based upon noise-mapping results - to manage noise issues and effects, including noise reduction, if necessary.

The END also draws the attention of protecting and planning *quiet areas* as an effective measure to reduce noise pollution and it defines the concepts of a "quiet area in open country" and a "quiet area in an agglomeration", by applying "noise indicators" and thresholds which should set up by the respective Member States. On the other hand, the END does not provide any common methodology to protect and plan quiet areas. Consequently, in order to implement the measure of "quiet areas", the Member States have experimented with diverse methods, developed on the municipality level and by means of European funded research projects (e.g. QSIDE, Hosannah, Listen, QUADMAP, etc.) as reported in (EEA 2014; Licitra et al. 2011).

From a literature review, it has emerged that main criteria applied could be classified as:

- Acoustical criteria, such as "noise indicators" defined by the Member States;
- Distance-based criteria;
- Mixed criteria: composed of acoustical, size-based and land use-based criteria, as it is the case of Berlin in Germany (Berlin Senate 2008); or the integration of acoustical criteria with accessibility-based criteria, as it is the case of Pisa in Italy (Licitra et al. 2011), the SCOPE indicator (Botteldooren et al. 2006), the TRAPT/TR indicators (Watts et al. 2013) - to name only a few.

On the other hand, in professional and academic environments a growing interest towards the inspection of qualitative definition of concepts like quietness and tranquillity has been registered. Petersen (2016) defines quietness as a combination of "outer experiences and inner sensations", whereas Nielsen et al. (2016) inspect the issue of quiet areas in cities, by tracing relationships "between material and immaterial qualities" of "urban spaces, […] on confluences of soundscape, cityscape, flowscape, and other scapes". And the London-based "Tranquil City" project (Tranquil City 2017), inspects the concept of "tranquillity", considered as "wholly

subjective", by asking people to share short videos of what they consider being tranquil spaces in London.

Notwithstanding, the European Environment Agency has pointed out that there is still the need for in-depth research in the field and has encouraged scholars to experiment especially with ***mixed*** methodologies, by integrating more qualitative approaches – such as the *soundscape approach* - with the more quantitative ones, based on "noise indicators" (EEA 2014).

Against this background, the "Beyond the Noise: Open Source Soundscapes" (Radicchi 2017d) project aims to fill this gap of knowledge, by proposing a novel mixed methodology to identify, assess and plan "everyday quiet areas" in cities, based on the soundscape approach, the citizen science paradigm and a novel mobile application: the "Hush City" app (Radicchi 2017b).

2. "QUIETNESS AS A COMMONS": INSPECTING THE ISSUE OF QUIET AREAS THROUGH THE LENS OF SOUNDSCAPE

In the past decades the *soundscape approach* has been developed in diverse disciplinary fields by researchers in Europe and beyond who referred to the early concepts from the 1960's by R. M. Schafer and by the *World Soundscape Project* group (Karlsson 2000, Radicchi 2017c). Recently, this approach has been proved by the COST Group on Soundscape – among others - to be essential to improve the quality of life in urban areas (Kang at al., 2013; Kang and Schulte-Fortkamp 2016). This importance has also been confirmed by the development of the *ISO standard norms*, which provide theoretical and methodological frameworks for soundscape definition, analyses and evaluation. According to the ISO norm, a soundscape can be understood as "an environment of sound (or sonic environment) with emphasis on the way it is perceived and understood by the individual, or by a society" (ISO 2014).

In general terms, the soundscape approach implies three main assumptions:

- the soundscape is rather a "resource" (Schulte-Fortkamp 2013) than merely noise;
- soundscape analyses and evaluation processes are usually placed in context (Kang et al. 2016);
- people's preferences as well as their perceptual and physical evaluations are combined towards a holistic study of the (sonic) environment (Brooks and Schulte-Fortkamp 2016).

By addressing the issue of quiet areas through the lens of soundscape, the research project's hypothesis has been formulated: quiet areas should be considered as a commons: as those "cultural and natural resources accessible to all members of a society […]" (Wikipedia) which should be "co-governed by its user community, according to the rules and norms of that community." (Bauwens et al. 2017).

Consequently, a novel definition of "everyday quiet area" is proposed as "a small, public, quiet spot embedded in the city fabric, at a walking distance from the places we work and live, where social interaction and spoken communication are not only undisturbed, but even favored" (Radicchi 2017d). According to this definition, the research project's hypothesis is that a combination of diverse qualitative and quantitative criteria should be applied in the identification and evaluation of quiet areas in cities, such as: people's preferences, accessibility, small size (< 1ha), neighbourhood scale (< 30 ha, in the case of Berlin), the walking distance paradigm (Welle et al. 2015). These hypotheses have to be validated through the citizen-driven pilot study.

3. CITIZEN SCIENCE APPLIED TO SOUNDSCAPE RESEARCH IN URBAN QUIET AREAS

In its formulation, the END also calls for informing and involving the public in preparing noise maps and action plans (END 2002, art. 8, 9), however it does not suggest any strategy to achieve this goal. Accordingly, major cities required to implement noise maps and noise actions plans have developed their own strategies. In Germany, for instance, the municipality of Berlin launched the on site and online campaign *Berlin wird leiser* from January, 24 to February, 22 2013 to ask people to communicate noise complaints and indicate the noisiest places in the city. The campaign was rather successful: approximately 3,000 comments and 1,900 online feedbacks were collected through workshops and the online platform. Also the possibility to send feedback via letter post was given to foster participation also among those who had no Internet access (<http://www.leises.berlin.de/informationen.html> Accessed on August 10, 2017). More in general, in small and medium-size German cities, we can register several cases were participation was included in noise action planning (Bonacker and Bachmeier 2016); however, despite few exceptions, public participation is still marginal in traditional environmental noise assessment and community noise programs.

On the other hand, the soundscape paradigm has become an important tool in facilitating people's involvement in soundscape evaluations and decision processes about the sonic environment (Brooks and Schulte-Fortkamp 2016). Moreover, recently, according to (Lin, 2015), in soundscape research a range of sound maps have emerged through which users may share their soundscapes recordings online (e.g. the Toronto Sound Map, the Soundcities project and the 2015 *StadtKlang* project). This kind of maps can contribute to inform and involve the public in the process of planning the sonic environment as well as to fill the gap of knowledge caused by noise maps between the real experience of places and their sonic representation. For these reasons they seem to be suitable for being integrated into the acoustical planners' tools kit (Ludovico and Mauro, 2009; Zorzanello, 2011; Radicchi and Signorelli, 2015). Notwithstanding there is no evidence of case studies related to the implementation of these tools for the hybridisation of quantitative and quantitative data into a comprehensive methodology for soundscape planning. And especially in the frame of research in quiet areas, experimentation with digital new media to favour public participation is still at the very beginning, with few examples available (Matsinos et al. 2017).

Taking inspiration from citizen science trends towards the use of GPS-equipped smartphones as sensors in data collection and evaluations in the field of environmental noise - e.g. WideNoise, NoiseWatch - (Theunis et al. 2017), the idea of using a digital tool seemed to be the most innovative, as it could be used by means of smartphones and carried out by citizens in their everyday life, independently by the researchers. This assumption leads us to the notion of *open source*, the other key-word of the project, which means "something driven by its community" (Wikipedia) and therefore in the frame of this research project it is used to refer to the aim of empowering local communities to play an active role in quiet areas mapping, evaluation and planning processes, by using the Hush City app.

4. THE "OPEN SOURCE SOUNDSCAPES" METHODOLOGY

The "open source soundscapes" methodology implies public participation and it is implemented by means of a pilot study, which is designed to be experimental: therefore the results cannot be intended to be representative of the entire population. This methodology is

articulated in four phases: the analyses phase, the evaluation phase, the planning phase and the ex-post evaluation phase (Fig.1).

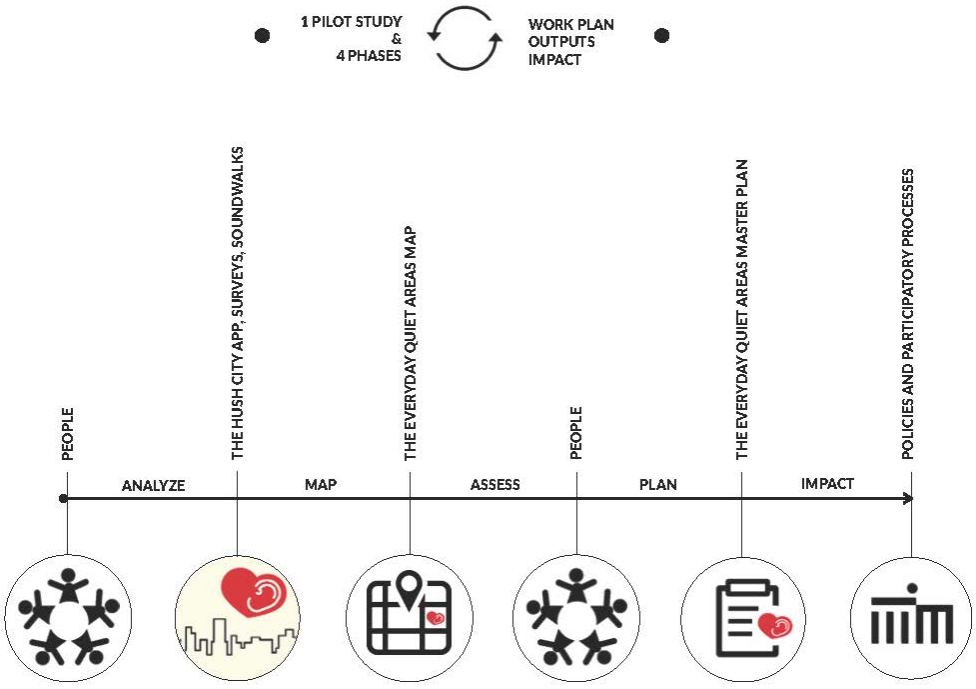

Figure 1. Diagram illustrating the workflow, the outputs and the expected impact of the "Beyond the Noise: Open Source Soundscapes" project. Image Source: (C) Antonella Radicchi 2017.

- ***The analyses phase***: in order to collect qualitative and quantitative data related to existing and potential "everyday quiet areas" in the fieldwork area, the following methods are applied: narrative interviews, group soundwalks, and data collection, by using the Hush City mobile app. The combination of these activities was envisioned in order to avoid social exclusion due to digital divide.
- ***The evaluation phase***: data collected will be analysed to design a map of "everyday quiet areas"; then they will be evaluated to better understand what quietness in cities is for people, and to validate the research project's hypotheses, the research questions and methods applied.
- ***The planning phase***: according to the results obtained from the data evaluation phase, the "Everyday Quiet Area Master Plan" will be drafted accompanying by a toolkit of planning guidelines on how to preserve existing "everyday quiet areas" and eventually planning new ones.
- ***The ex-post evaluation phase***: in order to make ex-post evaluations and to disseminate the project's results, the following activities will be addressed: working sessions with the population involved in the project in order to discuss and evaluate the results; a conference where results are presented to the public and discussed; a permanent exhibition in a space chosen in accordance with the the StadtteilBüro Reuterkiez, where the local community can have access to and interact with the project results. Then, data from the working sessions and public presentations will be fed into the project outcomes.

5. THE PILOT STUDY

The "open source soundscapes" methodology is currently under validation through a pilot study in Berlin: here the municipality developed and adopted an official "Plan of Quiet Areas", in the framework of the Berlin Noise Reduction Plan released in 2008 in line with the END's requirements (Berlin Senate 2008). In this plan, quiet areas are identified according to two categories: "continuous open areas" and "recreational areas": the former are "forest, green spaces, parks, fields, farmland and meadows", bigger than 100 hectares and with noise levels below 55 dB(A); the latter are "green areas and recreational areas near residential areas within walking distance", bigger than 30 hectares and characterized by a relative noise level threshold of 6dB(A). That is, in the recreational areas the sound pressure levels at their cores should be 6dB(A) lower than the levels measured at their borders. This goal of identifying and protecting quiet areas "within walking distance" from residential areas was only partially addressed, however, as the graphic analyses of the "recreational areas" identified within the Inner City of Berlin clearly demonstrate.

By implementing the "open source soundscapes" methodology this gap could be filled and the ultimate goal of building a network of quiet areas at a walking distance from the places people live (and work) could be achieved.

The pilot study has been implemented in the Reuterkiez, a Berlin "kiez" (neighbourhood) located in the district of Neukölln, which is affected by significant social and urban changes (e.g. "turistification" processes) and high levels of environmental stress/pollutants and therefore classified as subject to environmental injustice. According to the Berlin Environmental Justice Atlas, "the term environmental justice refers to the type, extent and consequences of the unequal social distribution of environmental loads and to its reasons." (Berlin Senate 2015). Consequently, environmental justice refers to the integrated levels of pollution affecting Berlin, which are calculated by combining the following core indicators: air pollution, noise load, accessibility to green spaces, thermal load, and social issues. The Reuterkiez is among those areas most affected by environmental injustice and it was selected by comparing a set of nine pre-defined criteria, such as: environmental justice index, position, size, morphology, land use, social diversity, proximity to quiet areas listed in the official Plan of Berlin Quiet Areas, accessibility to green areas, soundscape quality (Radicchi 2017d).

The pilot study has been conducted in collaboration with the StadtteilBüro Reuterkiez, a governmental office established under the framework of the EU and nationally funded "Social City" program, which has its venue in the neighbourhood and serves as a starting point for local residents, initiatives and associations that are committed to support each other. This collaboration has facilitated the organization of many activities such as: participant recruitment, public presentations, group soundwalks, network development with local groups and associations, active involvement in the everyday life of the kiez. "Community hours" were also offered at the Kinder Kiosk in Reuterplatz, the core area of the kiez, in order to disseminate the project and get people informed and involved in its fieldwork activities, such as: open interviews, groups soundwalks and data collection, by using the Hush City app, as detailed hereafter.

A. NARRATIVE INTERVIEWS

Semi-structured interviews (approximately 30) have been conducted with both experts and "local experts", meaning the daily inhabitants of an environment, who provide their expertise to researchers, investigators and project designers (Brooks and Schulte-Fortkamp 2016), such as: people from local organizations, sound artists, and people working and/or living in the kiez. Interviewees are first asked whether they live and/or work in the neighborhood or are visitors. Then, open questions follow up, focusing on: if they have favorite quiet spots in the

neighborhood, and if yes, where and why, whether they would favor protection for their favorite quite spots, and whether they would like to participate in group soundwalks and/or use the Hush City app.

B. SOUNDWALKS

Soundwalks have been conducted in the kiez with both experts and "local experts" (Brooks and Schulte-Fortkamp 2016), such as: people from local organizations, people working and/or living in the kiez, young students from the Rütlischule, students from TU Berlin who acted as occasional visitors. A soundwalk is "any excursion whose main purpose is listening to the environment" (Westerkamp 1974): in the frame of the pilot study diverse methods have been applied to design them, according to the "4 Variations" scheme outlined in "A Pocket Guide to Soundwalking" (Radicchi 2017a), which derives from a literature review and the author's practice. Accordingly, both silent soundwalks and soundwalks with complex evaluation points have been performed in order to sensitize participants towards the importance of quietness in cities and to involve them in quiet areas analyses and evaluation processes.

In the case of the "silent walk", the group was guided along a predefined path, at a slow pace, in silence. At each of the five listening stops identified along the path, the group stopped and listened to the environment for one minute, in silence. At the end of the soundwalk, a group discussion took place. Participants were then asked to go back to the area in the following days and map their favorite quiet areas, by using the Hush City app.

In the case of the "soundwalks with complex evaluation points", the group was guided along a predefined path, at a slow pace, in silence. At each of the five evaluation stops identified along the path, the group stopped and listened to the environment for one minute, in silence. Then, the participants were invited to provide their feedback, by replying to a pre-defined questionnaire. In parallel, audio recordings and A-weighted sound level measurements were collected by the researcher, by using a ZOOM H4n and a SAUTER SU 130 sound level meter, respectively. At the end, a group discussion took place.

C. THE HUSH CITY APP

The Hush City app (Fig. 2) is aimed to facilitates people in the collection and evaluation of quantitative and qualitative data related to their favoured "everyday quiet areas", by enabling the simultaneous and sequential actions of: recording sounds and calculating their noise pressure levels; taking pictures of the place where the sounds are recorded; collecting user feedback on the sounds recorded by means of a predefined questionnaire. The Hush City app was developed from scratch after a review of the state of the art of mobile apps available on the market, which highlighted the lack of a mobile app with those characteristics (Radicchi 2017b).

According to (Radicchi 2017b), twenty-eight mobile applications have been developed in the course of the past nine years: Noise Tube app has been the first one launched in 2008. After that, twenty-seven apps were launched in the following years, with a peak in 2014; they are (in alphabetical order): AirCasting, Ambiciti (improvement of SoundCity) Audio Spook, CART-ASUR, Citi-Sense, CITY SOUNDSCAPE, Ear-Phone, Geluidenjager - Sound of the Netherlands, I-SAY, MoSart, NoiseDroid, Noisemap, NoiseSpy, Noise Watch, Noise Tube, NoTours, Radio Aporee, Recho, Record the Earth, Sound City, Soundscape Characterization Tool, Soundsslike, Stereopublic, The Quiet Walk, The Noise App, Think About Sound, UrbanRemix, WideNoise

Out of the twenty-eight, sixteen are noise meter-based applications and twelve are audio recorder-based ones. Some of them also allow for the collection of mixed data, such as noise

levels and user feedback (e.g. Noise Tube, CART-ASUR), audio recordings and user feedback collection (e.g. Think About Sound).

By developing a tool which collects both qualitative and quantitative data, there was also the attempt of building a bridge between the noise level-oriented approach - practiced by acoustic planning - and a more qualitative and people-oriented one - applied in soundscape research (Radicchi 2017b).

Figure 2. The Hush City app's logo. Image Source © Antonella Radicchi 2017.

The Hush City app offers the users two options: they can map and evaluate "everyday quiet areas" in their neighborhoods; and/or they can use the app to identify "everyday quiet spots" nearby mapped by other members of the community. By accessing the Hush City app's home page, users are invited to select which action they would like to make, through two buttons displayed on the screen: "Map the quietness around you" and "Quiet Areas". In addition to these features, a bottom menu allows the users to: return to home page; consult and eventually delete their own surveys; give feedback on the app; manage users account settings (e.g. change the password). Finally the Search button allows for consulting quiet areas mapped in specific cities, by typing the name of the desired city in the blank space.

A user guideline has been developed in order to support the participants in the pilot study and also people interested in participating in the "Hush City" project and crowdsourcing quietness worldwide. In the case of the pilot study in the Reuterkiez, data collected by participants - by means of the Hush City app, narrative interviews and group soundwalk - will be then evaluated and they will constitute the basis for the development of the "Everyday Quiet Areas Masterplan", as described hereafter.

D. THE EVERYDAY QUIET AREAS MASTERPLAN

The Hush City app and the "Everyday Quiet Areas Master plan" constitute the open source outputs of the project. The latter is a participative management plan, which takes the results obtained at local level and scales them up to the city level, by:

- Providing indications on how to protect existing quiet areas identified by the local communities and how to plan new ones, in the medium-long term;
- Defining these indications taking into account complementary city plans, such as: the official quiet areas plan, the urban mobility plan, the land use plan, the green areas plan, to mention only a few.

The "Everyday Quiet Areas Master plan" will be developed in the participatory planning phase of the project, which will start in the midst of October 2017.

6. IMPACT

The "open source soundscapes" methodology could be applied to other Berlin neighborhoods and potentially to other cities worldwide, affected by noise pollution and environmental injustice, leading to insightful comparative studies. Grounded on the concept of "quietness as a commons", the methodology's theoretical, methodological and political impact could be measured on different levels.

- In relation to the scientific debate on the theories, tools and regulations of acoustic planning at the EU level: the novel mixed methodology, with its new definition and new open source tools proposed, can contribute to plan a network of small, quiet areas in cities starting from public participation and embedding people's preferences into open source planning processes.
- In relation to the knowledge generated by the project, it could be embedded within civic participation management, spatial planning networks and policy processes through the collaboration with local authorities. In the case of Berlin, in collaboration with the StadtteilBüro Reuterkiez, the implementation of specific activities ensures the positive impact of the project on the neighborhood, even after the end of the project. In detail, two activities have been envisioned:
    - A one-day long workshop to train people in soundscape action research: they will be able to exploit the project results and diffuse the soundscape culture in the neighborhood.
    - The "Soundwalking in the kiez!" program, run in collaboration with the Rütlischule based in the kiez. The program was kicked off in the frame of the International Noise Awareness Day 2017: in the next years a soundwalk will be organized and guided by one of the "community experts in soundscape" to celebrate the International Noise Awareness Day. (Radicchi 2017d).

7. DISCUSSION

As of June, 15 2017, we were in the midst of the analyses phases: 10 out of 30 interviews were made, 2 out of 4 soundwalks were performed, 45 datasets were collected by participants in the Reuterkiez, by using the Hush City app.

From an initial evaluation of data collected through the interviews, soundwalks, and the Hush City app, interesting results have emerged, pointing out that the concept of quietness in cities as perceived by people goes beyond the common association with greenery and the definition based on DB ratio. "For me, an urban quiet spot is a public space where I can stand or sit, it should not necessarily be silent, but with less noises from traffic! And I'd love to have people around me talking and kids playing!", said, for instance, interviewee no. 4; and again, "Quiet places are where sociality is favoured and art expression encouraged!", reported interviewee no. 7. This association between "quiet areas", expected on the local scale, and vibrant, pleasant places resulted also from a cross evaluation of data collected by using the Hush City app.

Hush City app was launched on the market in the midst of April 2017. Initial communication campaign's measures consisted of disseminating the app by means of emails to personal contacts and posts on public platforms such as LinkedIn and Twitter. As of June 15, 2017, approximately 170 datasets have been shared by users from all around the world: thee most active cities are Berlin (GER), followed by Cambridge (USA) and Lisbon (P). A number of datasets also come from the U.S. (e.g. New York City, Chicago), Italy (e.g. Rome, Florence, Milan, Bologna,), Romania (e.g. Bucarest), U.K. (e.g. London), Belgium (e.g. Ghent) and the Netherlands. In the case of Berlin, 55 datasets were collected, mainly in the Reuterkiez by participants in the project:

among these, 42% of the quiet areas mapped were tagged as “lively”, whereas 22% as “relaxing” and 18% as “familiar”. Other adjectives include: “pleasant” (9%), “meaningful”, “boring”, “natural”, “informative” and “beautiful” (all at 2%). However, a more complete and accurate data evaluation will be developed in the course of September 2017 at the end of the analysis phase.

As reported in (Kardous and Shaw 2014; 2016), problems remain with using smartphones to collect and document sound exposure data: in regard to the Hush City app, the main challenges are related to data quality, knowledge production and civic awareness and bottom-up participation processes.

With regard to the issue of data quality, (Murphy and King 2016) proved that the measurements apps did a poorer job of accurately measuring at very low background and high noise levels: the latter is a concern given that environmental noise at higher levels is the key area of concern from a public health perspective. Accordingly, in order to test the ability of the Hush City app to calculate noise at different sound pressure levels (i.e. Background, 40 dB, 50 dB, 60 dB, 70 dB), a manual calibration procedure was followed, as recommended by (Murphy and King 2016). A coherent pink noise signal was played over computer speakers and measurements were simultaneously taken by using the Hush City app installed on a Samsung Galaxy A5 and a calibrated sound meter level (NTI XL2). The microphones of the smartphone and the sound meter level had the same distance in front of the speaker (30 cm). In the case of the Hush City app on a Samsung Galaxy A5, the measured values differed by an average of -4 to -5 dB (A) at an average level (Laeq) of 45-80 dB(A). Below 45 dB(A), the differences become larger (approximately -10 dB(A)). That means the calculations made with Samsung Galaxy A5 smartphones could be more inaccurate, the quieter the area is. This result does not constitute per se a relevant weakness, due to the fact that in cities small, quiet spots with sound pressure levels below of 45 dB(A) are barely found. However, for more credible results, future work may imply calibration tests with different smartphones.

With regard to the issue of knowledge production, (Brooks and Schulte-Fortkamp 2016) highly recommend the integration of sound pressure level measurements with field recordings, psychoacoustic analyses and local experts’ feedback, in order to achieve proper soundscape evaluation processes. Hush City app’s originality consists in the multiple facilities which are embedded in a unique tool: by using the Hush City app, users can assess the sonic environment collecting datasets composed of: audio recordings, sound pressure level measurements, pictures and user feedback by means of a predefined questionnaire. This leads to the production of qualitative and quantitative data not only related to quietness, but also to other issues, such as: the visual aspect, quality, accessibility, weather condition, people behaviour – that can all influence the evaluation of the sonic environment (Kang et al. 2016).

Using the Hush City app allows for the bottom-up production of informative and descriptive datasets of the way people experience quietness in cities in everyday life. Despite the fact that maps constructed with such datasets may be less statistically relevant, they could still give useful information for investigating specific and context-related issues (Theunis et al. 2017); moreover they could constitute a resource to complement conventional methods for the assessment of urban noise (e.g. noise maps), as proven by previous experiments conducted in the field by (D’Hondt et al. 2013; Stevens 2012).

Lastly, in regard to the issue of bottom-up participation processes, in soundscape research, public participation and civic engagement play a major role in soundscape evaluation and planning processes (Brooks and Schulte-Fortkamp 2016); however sensing technologies applied to research on quiet areas is still at the very beginning, with very few available examples

(Matsinos et al. 2017). It is worth therefore to refer to geography, urban planning and citizen science where there has always been the tendency to support public participation (Haklay, 2017). Today innovation in sensing technologies leads to the development of miniaturised sensors, creating opportunities for *participatory sensing* (Loreto et al. 2017), data collection and monitoring at a reasonable price (Theunis et al. 2017). This trend is confirmed also by the increasing number of mobile apps developed to monitor noise and air quality, especially in urban environments (Radicchi 2017b).

The Hush City app is aimed to fill this gap of knowledge in regard to the issue of quiet areas, by: 1) increasing community awareness about the importance of reclaiming and protecting quietness in cities; 2) empowering local communities to map and evaluate quiet spots in their neighbourhoods; 3) impacting on participatory planning processes by training committed citizens in soundscape action research. However sustaining motivation to participate in such studies represents a challenge (Murphy and King 2016): to tackle it, specific measures (e.g. sending newsletters to the participants on a regular basis, publishing new posts on the project's website) will be adopted, following trends in citizen science projects' as recommended in (Nold and Francis 2017).

8. FUTURE WORK AND CONCLUSION

According to the workflow illustrated in Fig. 1, the planning phase is expected to start by the midst of October 2017. Future work may imply: the implementation of new features in the Hush City app (e.g. the possibility to select different languages; to filter the data); a further investigation of the quiet spots identified by the participants, by means of psychoacoustic analyses; comparative studies with other cities worldwide, such as: Cambridge (USA) where approximately 50 surveys were already made by using the Hush City app.

To conclude, to take action against noise pollution is imperative ad we strongly believe that the concept of "quietness as a commons" can be considered as appropriate to tackle this challenge and to achieve environmentally just, sustainable and participatory urban planning development not only in the city of Berlin.

ACKNOWLEDGMENTS

The "Beyond the Noise: Open Source Soundscapes" research project has been envisioned and is conducted by Dr. Antonella Radicchi (Technical University of Berlin).

Project Supervisors: Professor Dr. Dietrich Henckel (Technical University of Berlin), M.A. Jörg Kaptain (Berlin Senate, Senate Department for the Environment, Transport and Climate Protection). Acoustic Consultants: M.A. Michael Jäcker-Cüppers (DEGA), Dipl. Ing. Manuel Frost (Berlin Senate, Senate Department for the Environment, Transport and Climate Protection), Dipl. Ing. Mattia Cobianchi (Bowers & Wilkins, UK). Software Development: QUERTEX GmbH (GER) in cooperation with EdgeWorks Software Ltd. Statistical analysis consultant: M.Sc Finance. Edoardo Radicchi.

The pilot study is conducted in collaboration with the Stadtteilbüro Reuterkiez.

The project has received the no-profit institutional support of the Berlin Senate and it has been developed in accordance with the Berlin Senate, Senate Department for the Environment, Transport and Climate Protection.

The research project has received funding from the IPODI-Marie Curie Fellowship – People Programme (Marie Curie Actions) of the European Union's Seventh Framework Programme (FP7/2007-2013) under REA grant agreement no. 600209 (TU Berlin/IPODI).

The participation in the Acoustics17 conference in Boston and the delivery of this paper have been supported by an Head-Genuit Foundation Travel Grant.

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