Research Article

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Citizens as smart, active sensors for a quiet and just city. The case of the "open source soundscapes" approach to identify, assess and plan "everyday quiet areas" in cities

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Abstract: Today the so-called "smart city" is connoted by massive implementation of novel, digital technology, which is often considered as the best solution to global issues affecting contemporary cities. Sophisticated and low-cost technological solutions are developed also in the field of noise monitoring and they are expected to play an important role for acousticians, city planners and policy makers. However, the "smart city" paradigm is controversial: it relies on advanced technological solutions, yet it fails to consider the city as a social construct and it often overlooks the role of citizens, in the quest for technological advances and novel methods. This is especially true in the field of smart acoustic solutions addressing the issue of urban quiet areas: main methods and technologies developed so far barely involve citizens and consider their preferences. This contribution tackles this challenge, by illustrating a novel mixed methodology, which combines the soundscape approach, the citizen science paradigm and a novel mobile application – the Hush City app – with the ultimate goal of involving people in identifying, assessing and planning urban quiet areas. Firstly, the theoretical background and the methods applied are described; secondly initial findings are discussed; thirdly potential impact and future work are outlined.

Keywords: Smart city, END 49/2002, quiet areas, soundscape research, noise pollution, citizen science, open source, mobile applications, mapping, planning

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1 Introduction

In 1966, the radical architect Cedric Price (1933 – 2003) posed this provocative question: "Technology is the answer, but what was the question?" as the title of his lecture, drawing attention to an ever-pressing issue when facing, when we face the increasing number of novel, digital technologies developed for the so-called "smart city" [1]. In mainstream literature and on the media, the paradigm of the "smart city" is usually applied to promote the idea that massive implementation of novel technology (*e.g.* Internet of Things, digital infrastructures and platforms, Artificial Intelligence, etc.) is the proper solution to sustainability challenges posed by global issues affecting contemporary big cities, such as population density, social injustice and environmental pollution. Criteria, such as efficiency, productivity, informativeness achieved and implemented through technology, are also applied to rate the smartness of cities [2, 3].

However, the "smart city" paradigm is controversial and cannot be taken for granted. It relies on advanced new technological solutions, yet perpetrating a rather old vision of the city envisioned in the past century – that one of the "functional city" – which was not able to create a successful social and urban life and had a negative impact on post-World War II urban planning and society at large, despite being designed in the name of efficiency, health and zoning [4, 5].

Today critical scholarships attempt to shift the discourse of the "smart city" towards the notion of the city as a socially constructed set of activities, practices and organizations [6], proposing new qualitative evaluation criteria, such as happiness [7], urban design and mental health [8] as well as human scale [9]. These alternative approaches open up a more holistic understanding of how technology shapes urban and social changes and they help to redefine the "smart city" paradigm by putting people back at the heart of the planning process [10–12].

As [13] reminds us, the role of the inhabitant of the city, the citizen, is often overlooked in the quest for technological advances and novelty of the smart city. This is especially true in the field of smart acoustic solutions envisioned to address noise pollution and, in detail, the lack of quietness in European cities.

According to [14], noise from road traffic constitutes the second most harmful environmental stressor in Europe, affecting over 125 million people every year [15] and causing health issues, such as cardiovascular disease, cognitive impairment, sleep disturbance, hypertension and annoyance [16]. To address the issue of noise pollution, the European Environmental Noise Directive 2002/49/EC [referred to hereafter as the "END"] was adopted in 2002 with the aim of establishing a common approach among the Member States, based upon quantitative measurements, *e.g.* "noise indicators", "noise maps" and "action plans" [17]. The End also the identification, protection and planning of quiet areas as effective measures to reduce noise pollution and it provides the definitions for "quiet area in the open country" and "quiet area in an agglomeration", by referring to noise indicators and thresholds, which should be set by the respective Member States.

To deal with the lack of a common methodology for identifying, protecting and planning quiet areas, the Member States have experimented with diverse methods developed in the framework of both local and EU-funded research projects [15, 18, 19]. From a literature review, it has emerged that quantitative criteria have been mainly applied for the identification of quiet areas such as: acoustical criteria, distance-based criteria; and mixed criteria [15, 20]. However, these criteria have been proved to be insufficient to understand the complexity of noise pollution and the lack of quietness in cities to the point that the European Environment Agency has encouraged scholars to experiment particularly with *mixed* methodologies, by integrating more qualitative approaches – such as the soundscape approach – with the more quantitative ones, based on "noise indicators" [15].

If we refer to the definition released by the ISO norm, the soundscape can be intended as the "acoustic environment as perceived, experienced, and/or understood by people, in context" [21] – a ground-breaking definition which sets up the basis to consider the soundscape as both an interdisciplinary and cross disciplinary qualitative concept.

Furthermore, integrating the soundscape approach within the traditional acoustic planning approach can have a positive impact in favouring public information and participation and contribute to filling a gap in literature. In its formulation, indeed, END calls for informing and involving the public ([17], art. 8, 9), but it fails to provide any strategy to achieve this goal. As a result, in the context of research on quiet areas public participation is still at the very beginning, and "people's preferences" is rarely applied as a criterion for identifying quiet areas, especially in Germany [15, 22, 23].

This contribution illustrates a novel mixed methodology – the "open source soundscapes" methodology – envisioned to actively involve people in identifying, assessing and planning "everyday quiet areas" in cities, by combining the soundscape approach, the citizen science paradigm and the use of a new mobile application – the Hush City app.

By describing the theoretical and methodological framework, illustrating the Hush City app's implementation and discussing the results, this contribution aims to offer an alternative approach to smart acoustic technologies, by proposing this vision of citizens as "smart, active sensors".

To recall the words of Cedric Price, technology has to be intended not as an answer, yet as a powerful mean to empower citizens in participatory processes of identification, assessment and planning of urban quiet areas. According to this vision, the Hush City app has been implemented to understand what quietness is for people in cities and, eventually, to propose measures and policies, based on the same preferences expressed by people using the Hush City app

2 Methods

The "open source soundscapes" methodology aims to actively involve people in identifying, assessing and planning "everyday quiet areas" in cities, by combining the soundscape approach, the citizen science paradigm and the use of a new mobile application – the Hush City app. The theoretical framework of the methodology is drawn from soundscape research and the theory of the commons, whereas its methods and tools are drawn from soundscape research and citizen science.

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 [24, 25]. 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 [26, 27]. 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 defined as the "acoustic environment as perceived, experienced, and/or understood by people, in context" [21]. Consequently, soundscape approach can be said to be grounded on three main assumptions: 1) the soundscape can be understood as a "pool of resources" [28] instead of being reduced to merely noise; 2) soundscape analyses and evaluation processes are placed in context [29]; 3) people's preferences as well as their perceptual and physical evaluations are combined towards a holistic study of the (sonic) environment [30].

Inspecting the issue of urban quiet areas through the lens of soundscape allows for assuming **quietness as a commons**, as "the cultural and natural resource accessible to all members of a society [...]" (https://en.wikipedia.org/wiki/Commons) which "[should be] co-governed by its user community, according to the rules and norms of that community." [31].

Based on this political assumption of "quietness as a commons", a novel operative definition of "everyday quiet area" is proposed and defined 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 favoured" [20].

According to this definition, a set of criteria are proposed for the identification, evaluation and planning of "everyday quiet areas" in cities. They are:

- People's preferences;
- Accessibility;
- Small size (< 1ha);
- Neighbourhood scale (< 30 ha, in the case of Berlin);
- The "walking distance" paradigm [32];
- The human voice module [33].

These hypotheses have been explored in the framework of the citizen-driven pilot study conducted in Berlin, in which public participation was favoured, by taking inspiration from trends in citizen science and soundscape research.

In regard to public participation, the soundscape approach has proven evidence of facilitating people's involvement in soundscape evaluation and decision processes about the sonic environment [30]. Furthermore, according to [34], in soundscape research a range of sound maps have emerged through which users may share their soundscape recordings online (*e.g.* the Toronto Sound Map, the Soundcities project, Firenze Sound Map, the 2015 StadtKlang project, etc.). These kinds of maps seem to be suitable for being integrated into the acoustical planners' tool kit [35–37] given their potential of informing the public about the quality of the sonic environment as well as of filling the gap of knowledge between the real experience of places and their sonic representation produced by means of noise maps. Nevertheless there is no evidence of case studies related to the implementation of these tools for the hybridization 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 [20].

Taking inspiration from citizen science trends in the use of GPS-equipped smartphones as sensors in data collection and evaluations in the field of environmental noise (*e.g.* WideNoise, NoiseWatch [38]), the idea of using a digital tool to identify, map and evaluate "everyday quiet areas" seemed to be appropriate, as it can be used by means of smartphones and carried out by citizens in their everyday life, independently of the researchers.

Today, the average smartphone has enough sophisticated technology, such as on-board microphones, GPS, time stamping, to make it an extraordinary mobile monitoring device. Moreover urban life style trends show that smartphone usage is increasing. According to the 2016 Ericsson Mobility report, as of May 2016, the total number of mobile subscriptions was around 7.4 billion, including 63 million new subscriptions, and 80% of all mobile subscribers use smartphones. Subscriptions associated with smartphones also continue to increase.

However, in the framework of the pilot study in the Reuterkiez in Berlin, additional methods, such as interviews and group soundwalks, were applied to avoid social exclusion due to the potential digital divide, as explained hereafter.

The pilot study

The "open source soundscapes" methodology has been validated in the framework of the "Beyond the Noise: Open Source Soundscapes" project [refereed to hereafter as the "Beyond the Noise"] [20], in which a citizen-driven pilot study has been conducted in the course of 2017 in the Reuterkiez, a Berlin neighbourhood affected by significant urban changes (*e.g.* "turistification" processes) and high levels of environmental injustice, exemplified by a combination of environmental stressors and social problems [39].

The pilot study revolves around four phases: the analyses phase, the evaluation phase, the planning and the ex-post evaluation ones– phases in which citizens have been actively involved (Figure 1), as explained below.

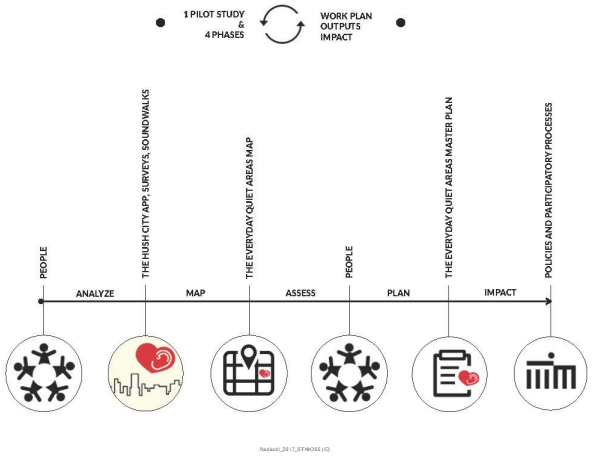

Figure 1: Diagram illustrating the workflow, the outputs and the expected impact of the "open source soundscapes" methodology. © A. Radicchi 2017

- In the analyses phase (May 2017 – September 2017), qualitative and quantitative data related to existing and potential "everyday quiet areas" were collected through the following methods: narrative interviews, group soundwalks and by using the Hush City mobile app.
- In the evaluation phase (October 2017 – December 2017), data collected was analysed and evaluated to validate the research project's hypotheses, the research questions and methods applied. As a result the "Reuterkiez Everyday Quiet Areas Map" (see Figure 10) was produced and discussed with community groups in the framework of the Reuterkiez Stadtteilkonferenz, a daylong community based conference, which took place on October 14 2017 in the pilot study's area.
- In the planning phase (January 2018 – March 2018), the "Reuterkiez Everyday Quiet Area Master Plan" will be defined along with a set of guidelines to suggest how to curate the existing quiet areas and eventually planning new ones.
- In the ex-post evaluation phase (January 2018 – March 2018), several public activities with the participants will be organized to discuss the results and include the participants' feedback into the final project report to be submitted to the Berlin Senate at the end of the project.

This citizen-driven **pilot study** is currently under development in Berlin, where the official "Plan of Quiet Areas" – was adopted within the framework of the 2008 Berlin Noise Reduction Plan [40]. This "Plan of Quiet Areas" identifies as quiet areas both "continuous open areas" and "recreational areas" on the city scale by applying a combination of acoustical, land use and size criteria. Accordingly, in the inner city, "recreational areas" are supposed to be "near residential areas within walking distance", larger than 30 hectares and characterized by a difference of 6dB(A) between the core of these areas and their surroundings. However, by inspecting the plan through the lens of the walking distance paradigm [32], it becomes clear that the application of the "walking distance" criterion was only partially addressed [20]. Moreover, the combined use of land-use and acoustical criteria results in being protective yet very conservative; on one hand, its application achieves the goal of protecting existing quiet areas, on the other hand it does not positively impact on environmental justice issues: quiet areas identified according to this method, indeed, mainly overlap with "landscape and nature protected areas" under the Berlin Conservation Law, *e.g.* parks and green areas belonging to the Landscape Conservation Plan [40].

In order to tackle this challenge and have a positive impact on environmental and social justices issues, the pilot study has been implemented in the Reuterkiez, a Berlin "kiez" (neighbourhood) located in the district of Neukölln, affected by significant levels of environmental 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." [39]. 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 [20].

This 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 neighbourhood. "Community hours" were also offered from May 2017 to August 2017 at the "Kinder Kiosk" (community kiosk) in Reuterplatz, the core area of the neighbourhood, in order to disseminate the project and get people informed and involved in the fieldwork activities, such as: semi-structured interviews, groups soundwalks and data collection, by using the Hush City app.

For the purpose of this contribution, only the Hush City app's development and implementation will be discussed in detail.

The Hush City mobile application

The Hush City app is a novel, free mobile application, which has been launched on the market in April 2017 as a tool to empower people to crowdsource, evaluate and map "everyday quiet areas" [41].

In order to explore the possibility to re-use an existing mobile app, a screening of mobile apps available on the market was conducted with the following results.

State of the art of mobile apps for crowdsourced noise & sound maps

The survey was conducted in-between June 2016 and October 2016 through literature and market review [38, 42–63].

Then, the state of the art outlined in (Table 1) was built, by selecting only:

1. Mobile applications for the collection of qualitative and quantitative data related to the sonic environment, such as noise pressure levels and/or audio recordings and/or user feedback and/or pictures;
2. Mobile applications for representing the crowdsourced data by means of web-based maps, such as noise maps and/or sound maps.

Social media mobile applications – such as Facebook, Instagram *et similaria* – were not included in this review. Furthermore, only the mobile applications covered by research publications (*e.g.* Ear-Phone) or implemented in the framework of research projects (*e.g.* CITI-SENSE) have been included in the survey, even if they are not yet or no longer available on the market.

The results of this survey outline that twenty-eight mobile applications have been developed in between 2008 and 2016, with a peak in 2014. They are (in chronological order): Noise Tube, WideNoise, NoiseDroid, NoiseSpy, NoTours, The Quiet Walk, URBANREMIX, Noise Watch, CITI-SENSE, Noisemap, I-SAY Sound Around You, Soundscape Characterization Tool, Ear-Phone, radio aporee, stereopublic, SoundOfTheCity, Cart-ASUR (linked to Noise Tube), Geluidenjager, Recho, Record the Earth, The Noise App, Sound City, AirCasting, Think About Sound, Ambiciti (new version of Sound City), City Soundscape, MoSart, Audio Spook.

Out of these twenty-eight apps, sixteen are noise meter-based applications and eleven are audio recorder-based ones. Only SoundOfTheCity works both as a sound recorder and as a noise meter, however the data collection process is not sequential. The majority of these apps 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), as reported in Table 1. Up to January 31 2018, some of the mobile apps are no longer or not yet available on the market, as specified in Table 1.

After reviewing the state of the art, the option to re-use an existing app was discarded, due to the lack on the market of a mobile application enabling the simultaneous and sequential collection of mixed data, such as: audio recordings and related noise pressure levels; pictures of the place where the sounds are recorded; user feedback on the location where the sounds are recorded, addressing a variety of issues, such as: the quality of the sonic environment and of the overall location, sense of security, accessibility, user behaviour, weather conditions, and many others (see below for more details). The possibility of using a web-based platform was also explored, in collaboration with Cristian Tapus (http://hushcityweb.azurewebsites.net/). However, this option was later discarded due to technical problems, mainly related to the impossibility of recording audio from iOS devices and to get accurate noise level measurements.

Consequently the Hush City app was developed from scratch.

Innovative aspects of the Hush City mobile app and goals

The most innovative aspects of the Hush City mobile application regard both the data collection and the data consultation processes.

Table 1: State of the art of mobile applications for crowdsourced noise & sound maps conducted in-between June 2016 and October 2016 © A. Radicchi 2018

Year of release	Name of the app	Availability on the market	Available for iOS	Available for Android	Geo-located data collection features				Sequential data collection process	Open data
					Audio recorder	Noise meter	Camera	User feed-back		
2008	Noise Tube	Yes	Yes	Yes	No	Yes	No	Yes	Yes	Yes
2009	WideNoise	Yes	Yes	Yes	No	Yes	No	Yes	Yes	No
2010	NoiseDroid	No	No	Yes	No	Yes	No	No	Yes	Yes
2010	NoiseSpy	No	No	Yes	No	Yes	No	Yes	Yes	No
2010	noTours	Yes	No	Yes	Yes	No	No	No	No	Yes
2011	The Quiet Walk	No	No	Yes	No	Yes	No	Yes	Yes	No
2011	URBANREMIX	No	Yes	No	Yes	No	Yes	No	Yes	No
2011	NoiseWatch	No	Yes	Yes	No	Yes	No	No	No	Yes
2012	CITI-SENSE	No	No	Yes	No	Yes	Yes	Yes	Yes	No
2012	Noisemap	Yes	No	Yes	No	Yes	No	No	No	Yes
2012	I-SAY Sound Around You	Yes	Yes	No	Yes	No	No	Yes	Yes	Yes
2013	Soundscape Characterization Tool	No	No	No	Yes	No	No	Yes	Yes	No
2013	Ear-Phone	No	No	No	No	Yes	No	No	No	No
2013	radio aporee	Yes	Yes	Yes	Yes	No	No	Yes	Yes	Yes
2013	stereopublic	No	Yes	No	Yes	No	No	No	No	Yes
2013	SoundOfTheCity	Yes	No	Yes	Yes	Yes	No	No	No	Yes
2014	Cart-ASUR (linked to NoiseTube)	Yes	No	Yes	No	Yes	No	Yes	Yes	Yes
2014	Geluidenjager	Yes	Yes	Yes	Yes	No	No	Yes	Yes	Yes
2014	Recho	Yes	Yes	No	Yes	No	No	No	No	No
2014	Record the Earth	Yes	Yes	Yes	Yes	No	No	Yes	Yes	No
2015	The Noise App	Yes	Yes	Yes	No	Yes	No	Yes	Yes	No
2015	Sound City	No	No	No	No	Yes	No	Yes	Yes	No
2016	Aircasting	Yes	No	Yes	No	Yes	No	No	No	No
2015	Think About Sound	Yes	Yes	Yes	Yes	No	No	Yes	Yes	Yes
2016	Ambiciti (new version of Sound City)	Yes	Yes	Yes	No	Yes	No	No	No	No
2016	City Soundscape	Yes	No	Yes	No	Yes	No	Yes	Yes	No
2016	MoSart	Yes	Yes	Yes	Yes	No	No	Yes	Yes	No
2016	Audiospook	No	No	Yes	No	Yes	No	No	No	No
2017	**Hush City**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**

In regard to innovation in data collection, **the Hush City app allows the sequential collection on the same location and by the same user of a complex set of mixed data in a limited timeframe** (approximately 3 minutes). The mixed collectable data consists of audio recordings and related noise pressure levels; pictures of the place where the sounds are recorded; user feedback on the location where the sounds are recorded. User feedback is collected by means of a predefined questionnaire, structured in three section: soundscape; general issue and behavioural issue. Questions are designed to explore the correlation between the soundscape and the following topics: emotional responses, semantic descriptors, perceived quietness, positive and negative sounds, level of oral interaction and social communication, sense of the place, landscape quality, level of maintenance and cleanliness, sense of security, accessibility to the location. Additional information collected through the questionnaire regards: major sound sources, user status, weather conditions, number of people in the areas and major activities performed in the area. The importance of collecting and evaluating both qualitative and quantitative data is also conveyed through the design of the app's icon, in which the profile of an ear is placed on a heart to represent this ideal combination. The hearth also refers to the impact of the sonic environment on our mental and physical heart (Figure 2).

The Hush City app also offers the possibility to collect multiple datasets on the same location by the same user or by different users, therefore allowing for further compara-

tive evaluation according to time variation (*e.g.* seasonal and/or day/night variations).

In regard to innovation in data consultation, the Hush City app allows to filter the "everyday quiet areas" identified and evaluated by the users according to a number of filters, such as: perceived quietness, sound pressure levels, semantic descriptors, sense of security, accessibility, quality of the landscape. Hush City also offers open access to the data collected by the users by means of a web-based platform. These two features will be developed in the second version of the app, available in May – June 2018.

Figure 2: The Hush City app's icon © A. Radicchi 2017

The Hush City app has been developed in order to achieve a set of ambitious goals: the most relevant ones are listed below.

1. To increase civic awareness of the importance of safeguarding urban quiet areas in cities.
2. To facilitate access to existing quiet areas, by allowing people to identify quiets areas shared by the community, where they can find relief from the hectic life experienced in big cities.
3. To boost public participation in the evaluation, protection and planning processes of quiet areas by providing people with a free and participative tool to crowdsource mixed data related to their favourite quiet spots.
4. To exploit data collected through he Hush City app in integrated city planning processes, in order to develop policies and planning guidelines grounded on people preferences, and therefore filling a gap in literature [22, 23].
5. To favour the building of a bridge between the noise level-oriented approach practiced by acoustic planning and a qualitative and people-oriented one, applied in soundscape research. The Hush City app indeed allows for the collection of mixed data – such as field recordings, noise level measurements, pictures and user feedback – which can be used to develop interdisciplinary and more proper evaluations of the sonic environment [30].

The Hush City app's concept

By accessing the Hush City app's home page, users are offered two main options through two buttons, displayed on the screen: "Map the quietness around you" and "Quiet Areas". In addition to these features, a 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 in specific cities, by typing the name of the desired city in the blank space (see Figure 3, 4).

By clicking on the button "Map the quietness around you", users are guided through data collection of their favourite "everyday quiet areas" (see Figure 3). The first action required is to record the sound of the chosen area: by clicking on the button "Record", the app starts recording and after 30 seconds it automatically stops. Secondly, users are asked to click on the button "Analyse" and the app calculates and displays the sound pressure levels of the sound recorded. Thirdly, users are asked to take a picture of the place where the sound was recorded, and finally they are invited to evaluate the soundscape and the surroundings by replying to a pre-defined questionnaire.

By using the Hush City app, data collection sequence starts with the recording of a 30-second long audio recording: This process was intentionally included in the app's design to make the users pause and listen to the sonic environment, therefore contributing to the improvement of their listening abilities.

The final step in data collection consists in replying to a pre-defined questionnaire, which is composed of 20 questions, articulated in three sections: 1) soundscape issues, 2) behavioural issues, 3) general issues. Replies can be given by means of: multiple choice, linear scale and free text rating methods. The questionnaire was designed referring to previous studies conducted in the field [15, 48, 64]. In detail, the first set of questions is aimed to investigating the sense of quietness in relation to: emotional responses, sound sources identified, semantic descriptor preferred, social interaction and oral communication promotion, identity of the place. The second one focuses on the functionality of the areas and human behaviour, the third one addresses general issues, such as people's status, weather conditions, visual quality of the areas, cleanliness, maintenance, sense of security, accessibility. A final blank space allows users to provide free and spontaneous comments.

By clicking on the button "Quiet Areas", users are guided through the exploration of datasets related to "everyday quiet areas" shared by other users nearby – or in

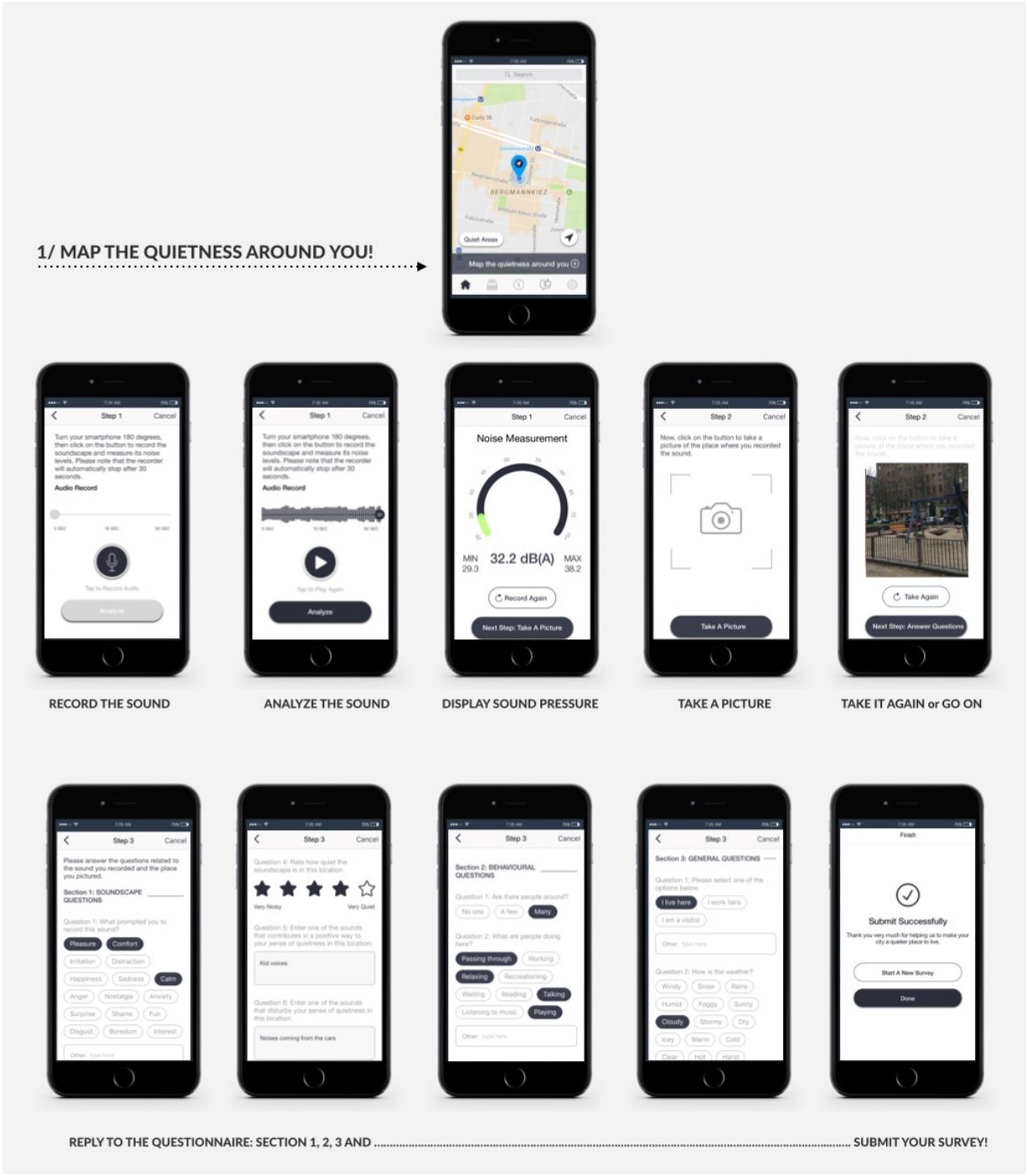

Figure 3: Hush City app: "Map the quietness around you" interface. © A. Radicchi 2017

other cities worldwide (see Figure 4). When the "Quiet Areas" button is active, the background map turns into dark and users are offered two view mode options to explore the quiet areas: the map view mode and the list view mode.

When the map view mode is active, colour markers are displayed on the dark background map. Colours are automatically assigned to the markers by the Hush City application, according to the sound pressure levels of each sound recorded. For example, light green markers indicate that in these spots sound pressure levels were approximately between 35-40 dB(A). The colour scale reference is taken from the strategic Noise Map of Florence. By clicking on each marker, a window pops up displaying data collected on that spot, such as: date and time, address, sound

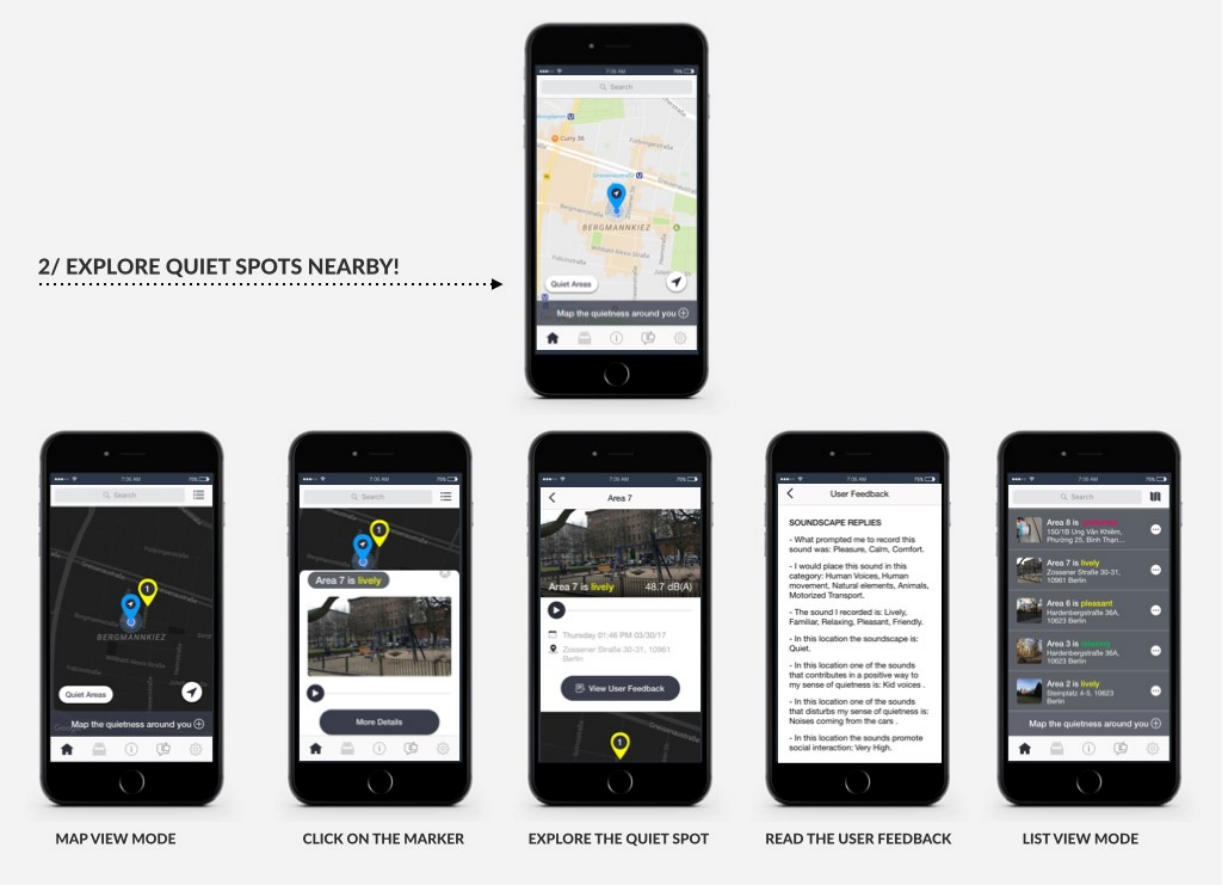

Figure 4: The Hush City app: "Quiet Areas" interface. © A. Radicchi 2017

recordings, pictures, sound pressure levels, and user feedback provided by the users by replying to the questionnaire.

When the map view mode is active, users are given the possibility to explore datasets also by means of the list view mode. By clicking on the button located on the top-right angle of the display (in the case of iPhones), datasets about "everyday quiet areas" crowdsourced by the community are listed. Again, by clicking on each item of the list, data collected on that spot are visualized, such as: date and time, address, sound recordings, pictures, sound pressure levels, and user feedback provided by the users by replying to the questionnaire.

The Hush City App's technology

Hush City app is a native mobile application, which runs on both iOS and Android operating systems: iOS 9.0 and higher (iPhones 5/5C/5S/SE/6/6Plus/7/7Plus) and Android 5 and higher (any Android based smartphone). A Titanium platform is used as a framework to record and store the data and a LAMP stack is used as a model of web service stacks. Audio data are sampled at 44.100Hz, with a resolution of 16bit. The maximum length of the audio file is 30 seconds. Respective sound pressure levels are calculated as numeric scale values and they are A-weighted (*i.e.* 45 dB(A)). The A-weight is considered as the most appropriate for assessing environmental noise, due to the similarity to human hearing [38]. L_{eq} (equivalent continuous sound level), L_{min} (minum sound level) and L_{max} (maximus sound level) are also calculated and displayed. NoiseTube's app libraries have been consulted to select the most appropriate formulas for sound pressure level calculation and calibration [50]. These formulas have also been double-checked by a team of acoustic consultants involved in the project (see the acknowledgments). Pictures are collected at a maximum resolution of 6MP and 24bit colour. Sign-in feature: the users must verify their email before signing in and using the app as usual. If the users realize that they used wrong emails or made typos or mistakes after touching the Sign Up button, the app also allows them to change their email addresses.

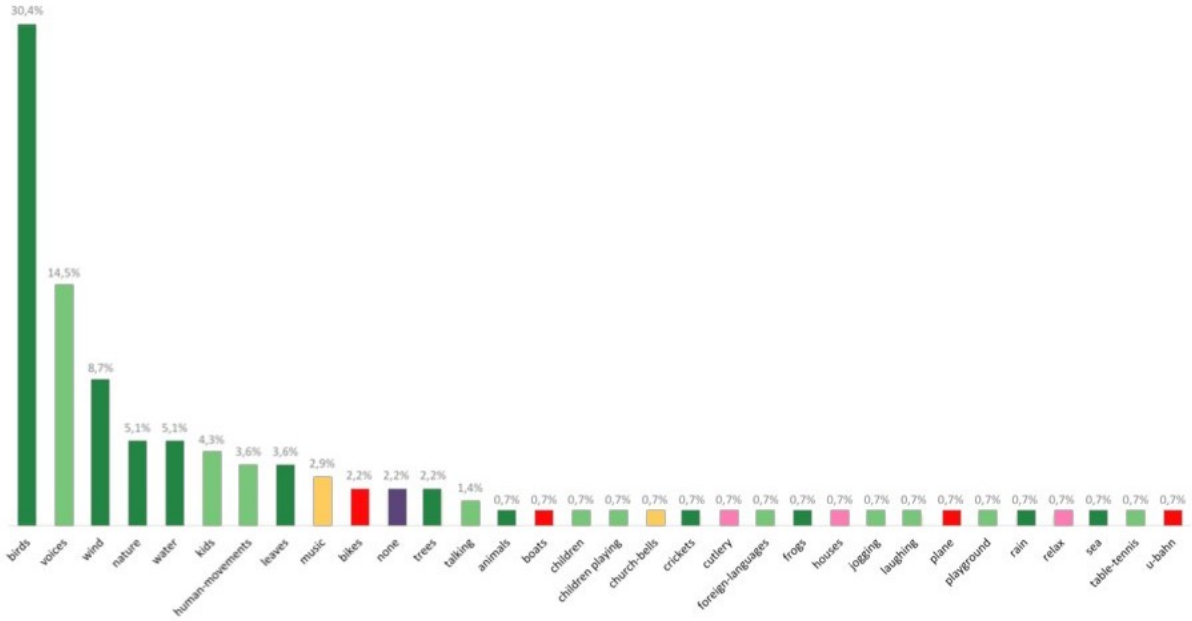

Figure 5: Diagram showing the sounds that contribute in a positive way to the app users' sense of quietness in the "everyday quiet areas". © A. Radicchi 2018

The Hush City app's code, data ownership, data storage and privacy issues

For the measurements and for compiling the maps on quietness, precise user location is needed. Various technologies are used to determine user location, including IP address, GPS, and other sensors. All and any collected data and personal information are sent anonymously to the Hush City app server hosted in Germany, where they are stored in a standard relational database. Appropriate measures are taken to safeguard against unauthorized disclosures of personally identifiable information and all information is stored using the required industry-standard techniques. The collected surveys are made available strictly anonymously on the Internet and by means of publications in international journals and public presentations at conferences, symposia, and dissemination events in general. The Privacy Policy and Terms and Conditions document is accessible at any time on the Hush City app's webpage.

3 Initial results

This citizen-driven pilot study was designed to be experimental and therefore the results cannot be intended as representative of the entire population, however they can be considered as indicative of the "open source soundscapes" methodology potential in achieving successful participatory processes in the identification and evaluation processes of quiet areas.

Given the richness of mixed data available related to the "everyday quiet areas" collected, new ideas for data evaluation and correlations have risen so far and additional analyses will be made in the next weeks. In the framework of this contribution, initial results are discussed, especially concerning the Hush City app's implementation.

Since its launch in April 2017, the general public's interest on the Hush City app has grown, despite the limited communication campaign capacity in the hands of the principal investigator of the project. As of November 2 2017, users from all around the world have collected 371 datasets, resulting in: 371 audio recordings, 371 calculated sound pressure levels, 371 pictures and 7420 user feedback, resulting from the replies given to the predefined questionnaire embedded in the app. The most active cities are Berlin (104 datasets), Bristol (80 datasets), Cambridge, USA (57), and New York City (10), but data were also submitted from Spain, Italy, Romania, Belgium, the Netherlands, Switzerland and Australia. People constantly crowdsourced "everyday quiet areas" from different countries: since November 3 2017 up to January 30 2018, for instance, the number of datasets collected by using the Hush City app has increased from 371 to 567 datasets.

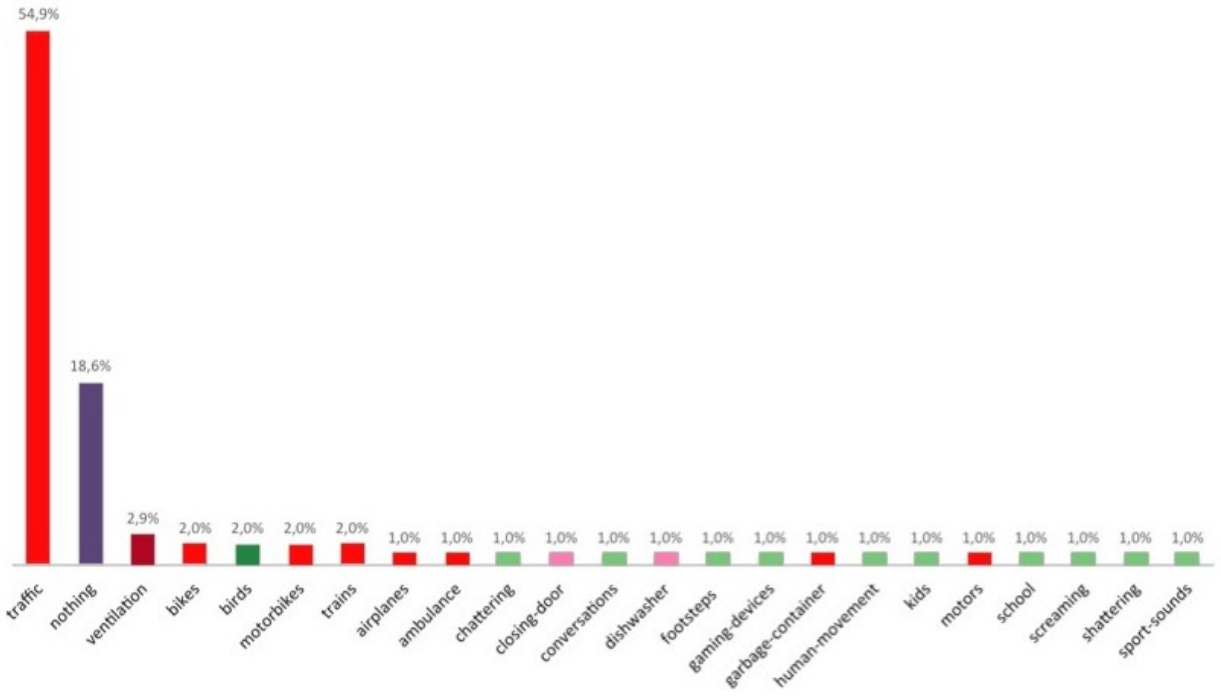

Figure 6: Diagram showing the sounds disturbing the app users' sense of quietness in the "everyday quiet areas" © A. Radicchi 2018

The initial evaluation of data collected in Berlin through interviews, soundwalks, and the Hush City app, has yielded interesting results, by providing a more complex understanding of the notion of quietness in cities, beyond the common definition based on decibel levels. In the interviews, people have referred to "everyday quiet areas" as places, which favour relaxation and social interaction, and are characterized by a mix of natural and human sounds. This association between "everyday quiet areas", expected on the local scale, and lively, yet relaxing places, resulted also from a cross evaluation of data collected through the soundwalks and the Hush City app.

In detail, regarding the latter, 104 datasets were collected, resulting in 104 audio recordings, 104 calculated sound pressure levels, 104 pictures and 2080 user feedback.

So far, data collected through he Hush City app have been analysed to investigate the following issues:

- The most common descriptors used to tag the "everyday quiet areas";
- The correlation between the perceived quietness and the capability of these areas to favour social interaction and promote oral communication;
- Sounds which positively contribute to the perception of quietness;
- Sounds which negatively contribute to the perception of quietness;
- The relationship between the perceived quietness and user behaviour in the "everyday quiet areas"
- The correlation between the level of quietness and sense of security, as perceived by the app's users in the "everyday quiet areas";
- The correlation between the level of quietness as perceived by the app's users and the noise levels calculated by the app in the "everyday quiet areas";
- The emotions that prompted the users to crowdsource "everyday quiet areas".

Accordingly, from an initial evaluation of data collected, it emerged that the most used semantic descriptors to tag the "everyday quiet areas" are "relaxing" (18%), "lively" (11%), familiar (5%), pleasant (4%), meaningful and friendly (2%). These data are collected through the app's questionnaire (question 3/section 1) by means of a multiple-choice rating scale.

In regard to the hypothesis that "everyday quiet areas" could be characterized by human voice-scale soundscapes, results indicate that "everyday quiet areas" evaluated as "quiet" have been also indicated as areas, which favour social interaction (21%) and encourage conversations (21%). Moreover, the sounds most indicated as contributing in a positive way to the sense of quietness are natural and human related sounds, coming from human voices (14,5%) and birds (30,4%). These data are collected

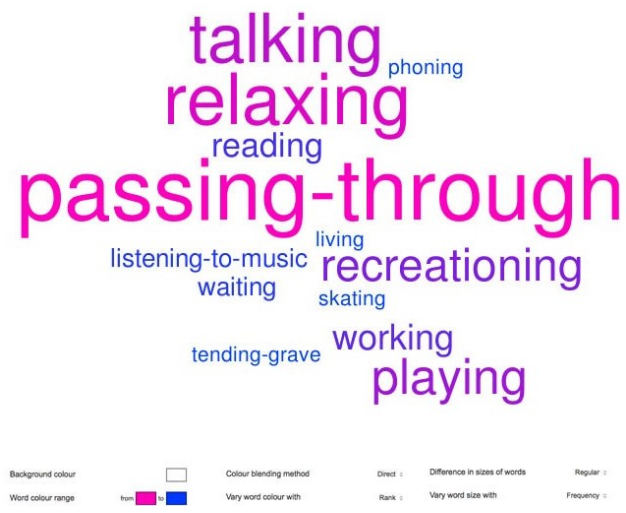

Figure 7: Word cloud representing the replies given to the question 2/section 2: What are people doing here? The size of the words varies according to the parameter: "frequency" © A. Radicchi 2018

through the app's questionnaire (question 5/section 1) by means of an open question – see Figure 5.

On the other hand, and not surprisingly, the sounds most indicated as contributing in a negative way to the sense of quietness are those coming from traffic (54,9%). These data are collected through the app's questionnaire (question 6/section 1) by means of an open question – see Figure 6.

Concerning the functionality of these areas and the correlation between activity, human behaviour and the sense of quietness, "everyday quiet areas" evaluated as "quiet" have been also indicated as places where there are relatively few (31%) and many (13%) people around, engaged in the following activities: passing-through (24,8%), talking (18,1%), relaxing (19,5%), recreationing (9,7), playing (11,1%), working (6%), reading (5,4%). These data are collected through the app's questionnaire (question 2/section 2) by means of a multiple-choice rating scale – see Figure 7.

Further correlations have been explored so far, between the perceived quietness and the sense of security as well as the perceived quietness and the visual quality of the location, its cleanliness, maintenance and accessibility. Results show a consistency between the level of quietness and the sense of security perceived by the app's users in the "everyday quiet areas": *e.g.* the sense of security was rated "very good" by 31% of the users in areas perceived as being "quiet". Data are collected through the app's questionnaire (question 4/section 1 & question 6/section 3) by means of linear rating scales – see Figure 8.

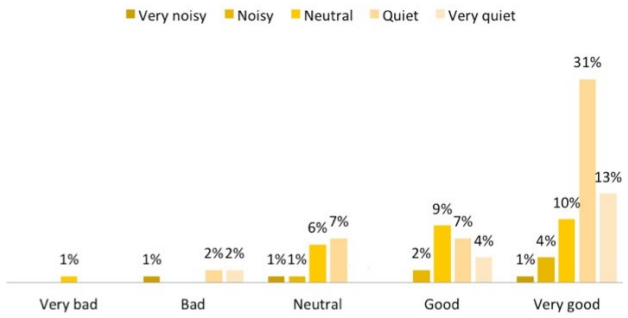

Figure 8: Diagram showing the consistent correlation between the level of quietness and sense of security, as both perceived by the app users in the "everyday quiet areas" © A. Radicchi 2018

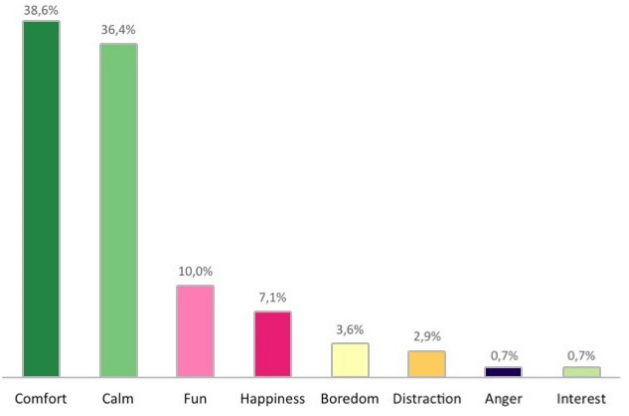

Figure 9: Diagram showing the emotions which prompted the app users to map the "everyday quiet areas" © A. Radicchi 2018

Concerning the correlation between the perceived quietness and the visual quality of the location, its cleanliness, maintenance and accessibility, results show a strong consistency. The majority of the users (74%) rated the visual quality of the "everyday quiet areas" as being good and very good; 68% of the users rated the "everyday quiet areas" as being both clean and very clean, and well and very well maintained; 82% of the users defined the "everyday quiet areas" well and very well accessible.

An additional analysis was performed to evaluate the correlation between the level of quietness as perceived by the app's users and the noise levels calculated by the app in the "everyday quiet areas". Again the results show a consistency: "everyday quiet areas" with noise levels in-between 45 dB(A) and 55 dB(A) are perceived as quiet and very quiet by the app's users.

In regard to the emotions which prompted the users to crowdsource "everyday quiet areas", positive feeling, such as: comfort, calm, fun, happiness were rated the most. These data are collected through the app's questionnaire (question 1/section 1) by means of a multiple-choice rating scale – see Figure 9.

Data collected by means of soundwalks, interviews and the use of the Hush City, were merged to produce the "Reuterkiez Everyday Quiet Areas Map" (see Figure 10, image on the left). This map shows the "everyday quiet areas" identified by the participants in the pilot study: the size of the purple circles placed on the map relates to the rating given by the participants, *e.g.* the bigger is the dot, the higher is the number of participants who indicated those areas as their favourite ones. The numbers displayed on the top of the dots refer to the pictures framing the map, which depict these quiet areas. In the pilot study area, the most rated "everyday quiet areas" are two squares, Reuterplazt and Weichselplatz, along with a specific section of the canal Paul-Linke Ufer. These areas are public, recreational places characterized by a mix of both urban and natural features, such as big trees, green lawns, playgrounds for children and adults and water infrastructures (*e.g.* the canal). All the three areas are embedded in the urban fabric of the city and lined with streets open to traffic; they are well equipped with street furniture, which were very much appreciated by participants in the project as tools favouring relaxed activities and social interaction (*e.g.* talking, reading a book, drinking a beer, etc.). Other areas identified by the participants in the pilot consist of: small playgrounds and hidden gardens, but also streets with less traffic and cafeterias with relaxing sitting areas. Streets corners were also indicated as "everyday quiet areas": spots that favor friendly conversations and cigarette breaks.

The "Reuterkiez Everyday Quiet Areas Map" was then discussed with community groups in the framework of the Reuterkiez Stadtteilkonferenz (community conference), which took place in the pilot study area on October 14 2017. The map was displayed and people were invited to evaluate the initial results, by playing an active game and placing post-its of different colours on the map, according to their agreement/disagreement with the results (*e.g.* red post-its for disagreement and green post-its for agreement). The most controversial "everyday quiet area" resulted in being the Reuterplatz, the core square of the neighbourhood, due to the ambivalence of quietness in relation to temporal and seasonal variation (see Figure 10, image on the right: the square lies under the multiple red post-its placed at the centre of the map). This ambivalent result will be considered in the next step of the project, when planning guidelines and potential regulations will be drafted with the participants in the project in order to improve and protect these "everyday quiet areas".

During the summer and autumn 2017, the Hush City app received a significant press coverage. The app was featured on newspaper articles (*e.g.* TU Intern, Berliner Zeitung, Berliner Kurier); several radio podcasts and online articles (http://www.opensourcesoundscapes.org/spread-the-word/press/). In parallel to this press coverage, a significant increase was registered in the collection of datasets by anonymous users (see Figure 11): this result highlights the importance of developing a proper communication campaign as a valid measure to retain and improve public participation. This measure will be implemented in the follow up study running April 2018 – April 2020.

In the absence of a cross-sector planning tool that includes specialist planning disciplines and policy-making processes in the realm of quiet areas [23], stakeholders involved in noise and urban planning processes, particularly from Germany and other European locations, such as Granada and Bristol, expressed keen interest in experimenting with the "open source soundscapes" methodology. In Granada, the methodology is under implementation at the University of Granada, Department of Applied Physics, under the supervision of Prof. Vida Marzano. In Bristol, the Hush City app was applied in the framework of a workshop, organized at the Landscape Institute by landscape architect Sarah Landsmith of Landsmith Associates and acoustician Paul Discoll of Ramboll Acoustics to further investigate the potential of the soundscape approach to landscape planning in regard to the issue of quietness. The Berlin Senate has also confirmed its support for the follow-up study, which will run in April 2018 – April 2020.

As mentioned earlier in the paper, given the richness of mixed data collected related to the "everyday quiet areas", new ideas for data evaluation and correlations have risen so far and additional analyses will be made in the next weeks. Additional cross-analyses will be performed to further investigate the sense of quietness in relation to: identified sound sources, identity of the place, weather conditions, and by analysing both the pictures and the audio recordings taken by the users in the "everyday quiet areas".

4 Discussion

In regard to the overall "open source soundscapes" methodology, main points of discussions revolve around the following issues: 1) definition of quiet areas in cities; 2) civic awareness and public participation; 3) knowledge production and social justice; 4) data quality and standardization.

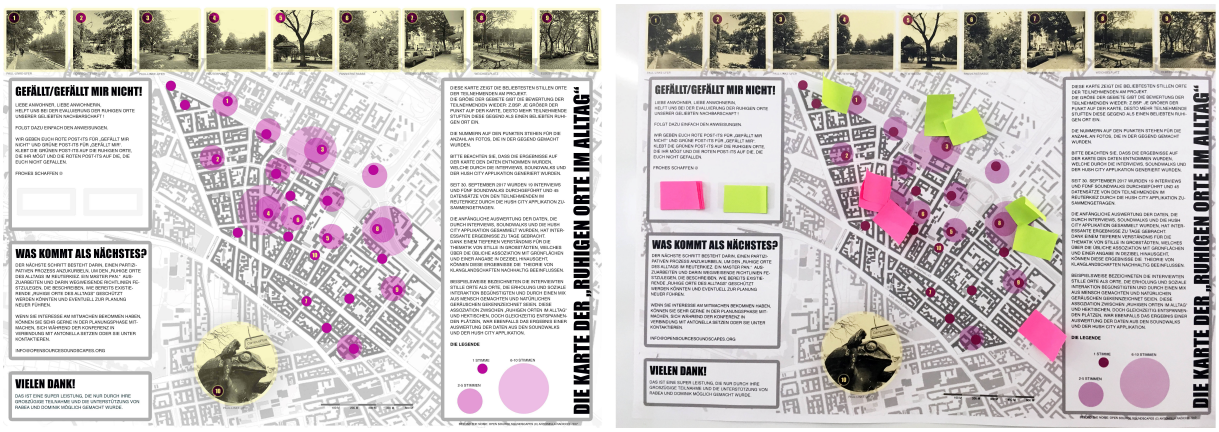

Figure 10: On the left, the "Reuterkiez Everyday Quiet Areas Map"; on the right, the results coming from the interactive game played with community groups at the Reuterkiez Stadtteilkonferenz © A. Radicchi 2017

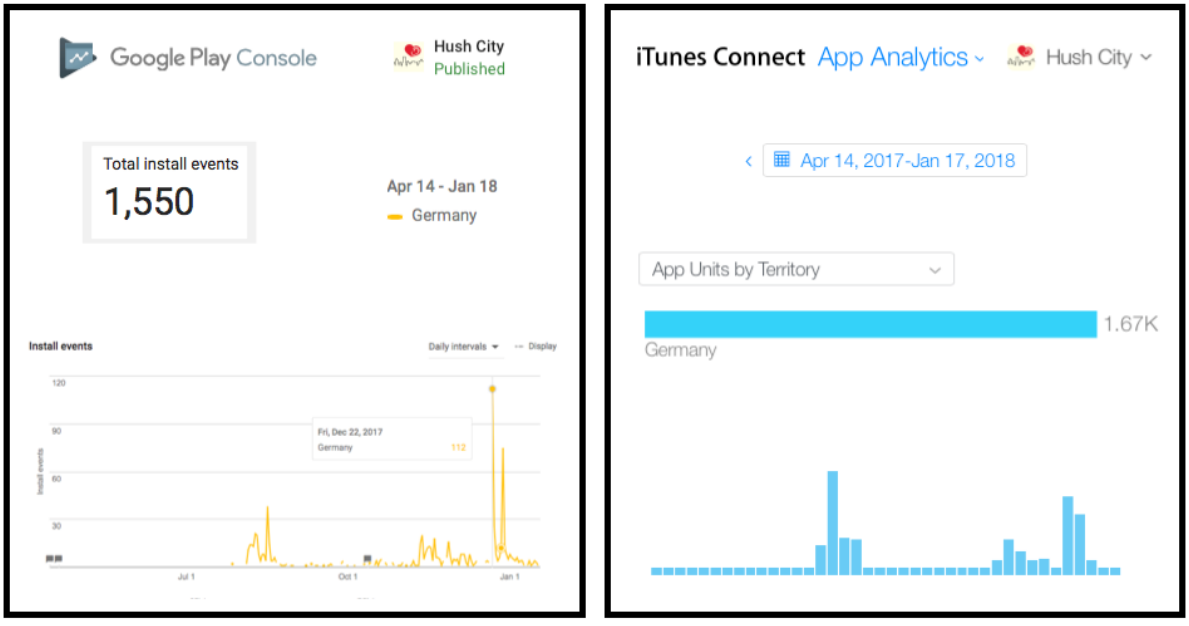

Figure 11: Analytics showing the number of install events & app units in Germany, both for iOS and Android. Installation's peaks correspond to the times in which the Hush City app received extensive press coverage © A. Radicchi 2018

Definition of quiet areas in cities

As anticipated in the introduction, the first definition of a "quiet area in an agglomeration" was released by the Environmental Noise Directive in 2002 as "an area, delimited by the competent authority, for instance which is not exposed to a value of L_{den} or of another appropriate noise indicator greater than a certain value set by the Member State, from any noise source" ([17], art. 3, l)). However, as suggested in [15], defining a quiet area only by the noise level is not adequate: a number of psychological factors occur when people identify an area as quiet and these factors cannot be measured through quantitative criteria. This insight, in combination with the limitations of calculated and measured sound-pressure levels, particularly with regard to quiet areas, has fuelled interest in soundscape studies and evaluation of user experiences [15]. Despite the methods developed by Member States to identify, protect and plan quiet areas, the criterion of people's preferences is still rarely applied, especially in Germany [15, 22, 23]. The "open source soundscapes" methodology addresses this gap of knowledge and, by arguing that **quietness is a commons,** it places people at the heart of the quiet areas evaluation and planning process.

The initial evaluation of data collected in Berlin through interviews, soundwalks, and the Hush City app already shows the capacity of the methodology to provide a more complex understanding of the notion of quietness in cities, beyond the common definition based on sound pressure level thresholds. In the interviews, people have referred to "everyday quiet areas" as places, which favour relaxation and social interaction, and are characterized by a mix of natural and human sounds. This association between "everyday quiet areas", expected on the local scale, and lively, yet relaxing places, resulted also from a cross evaluation of data collected through the soundwalks and the Hush City app. Moreover, areas evaluated as "quiet" have also been indicated as areas that favour social interaction and encourage having conversations. In this regard, the sounds most indicated as contributing in a positive way to the sense of quietness are those coming from birds and human voices. Concerning the functionality of these areas and the relationship between activity, human behaviour and the senses of quietness, areas evaluated as "quiet" has been also indicated as places where there are people around, passing-through, talking, relaxing and recreationing. These initial results shed some light on the relationship between activities in quiet areas and the appropriateness of various kinds of sounds, addressing open research questions as reported in [15, 65, 66].

Given the empirical nature of the results coming from a relatively limited amount of data, further actions are needed to boost public participation, collect more data and draw robust conclusions, especially to test the hypothesis of the human voice scale as a potential descriptor for "everyday quiet areas". To achieve this goal, several key actions have been identified – *e.g.* the development of a proper citizen science communication campaign – and they will be performed in a follow-up study, which will run in-between April 2018 – April 2020 and for which a third-party research grant has been already secured.

Civic awareness and public participation

In geography, urban planning and citizen science there has always been the tendency to support public participation [10, 67]. Today innovation in sensing technologies leads to the development of miniaturized sensors, creating opportunities for participatory sensing [49], data collection and monitoring at a reasonable price [38]. This trend is also confirmed by the increasing number of mobile apps developed to monitor noise quality, especially in urban environments (see Table 1). In soundscape research, public participation and civic engagement play a key role in soundscape evaluation and planning processes [30]; however sensing technologies applied to participatory research in quiet areas are still at the very beginning, with very few available examples [20].

The Hush City app, along with the other methods applied in the framework of the "open source soundscapes" methodology (*e.g.* interviews and soundwalks), is aimed to contribute to fill this gap of knowledge 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.

Both the implementation of the "open source soundscapes" methodology in the pilot study in Berlin and the use of the Hush City by people from other countries beyond Germany have confirmed the interest from the public on the issue of urban quiet areas and the willingness of citizens to be actively engaged in planning processes. However sustaining motivation to participate in this kind of studies is always an issue [51]: to tackle this challenge, specific measures have been adopted following trends in citizen science [68]: such as social media engagement and newsletter dissemination.

In the 2018 – 2020 follow-up study, in order to boost and retain public participation three key actions will be performed, which consist of: implementation of new features on the Hush City app; development of a proper citizen science communication campaign; and organization of additional group activities in Berlin.

Knowledge production and social justice

As reported in [15, 18, 27, 69] the quantitative methodology provided by the END is insufficient to understand the complex nature of noise pollution as it does not consider the influence of people's perception in the evaluation of the sonic environment, particularly in its characteristic of "quietness". A proper evaluation of the sonic environments calls for interdisciplinary measures [30] and the integration of sound pressure level measurements with field recordings, psychoacoustic analyses and local experts' feedback is highly recommended. The "open source soundscapes" methodology tackles this challenges by favouring the collection of mixed data, both qualitative and quantitative, through different methods, such as: interviews, soundwalks and by applying the Hush City app.

The Hush City app's originality consists in multiple facilities embedded in a unique tool, which allows users

to collect datasets, each one composed of the following mixed data: one 30-second long recording, its respective sound level calculation, one picture of the place where the audio recording is recorded and user feedback, provided by replying to the predefined questionnaire. This sequential data collection process leads to the production of qualitative and quantitative data, which inform about the perceived level of quietness of the areas and about a number of other issues – such as: the visual aspect, quality, accessibility, weather conditions, people behaviour etc. – that influence the evaluation of the sonic environment [15, 26]. In regard to interdisciplinary measures, future work will provide the Hush City app's implementation with new facilities to investigate psychoacoustics parameters in relation to the sense of quietness.

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 [38]; 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 [42, 52]. These assumptions have been confirmed also in the framework of the pilot study in Berlin: through the evaluation of mixed data and people's preferences expressed in relation to the sonic quality of the neighbourhood, it has emerged that high levels of noise pollution affect the neighbours – an issue not represented in the official Berlin Noise Map and therefore overlooked by the Berlin Senate.

The assumption of "quietness as a commons" and the active involvement of people in the identification and evaluation of quiet areas on the local scale can have also a positive impact on environmental and social justice issues. In the case of the official Plan of Quiet Areas of Berlin, for instance, the adoption of combined acoustical and land-use based criteria for the identification of quiet areas mainly led to the overlapping of quiet areas with "landscape and nature protected areas" under the Berlin Conservation Law, without bringing any significant improvement in neighbourhoods affected by environmental and social injustice levels. By using the Hush City app, people have identified a conspicuous number of "everyday quiet areas" which don't necessarily overlap with the main ones identified by the Berlin Quiet Areas plan, therefore contributing to the creation of an additional network of "everyday quiet areas", more equally distributed on the city scale. This network of "everyday quiet areas" reflects people's preferences and needs, and therefore it can constitute the starting point for the development of a democratic process regarding the definition of recommendations and policies on how to curate and protect these "everyday quiet areas".

Data quality and standardization

In the analyses phase of the "open source soundscapes" methodology, participatory data collection was performed by means of: interviews, soundwalks and by using the Hush City app. In regard to the use of smartphones as means to collect and document sound exposure data, challenges remain as reported in [45–47], despite the fact that some of the main issues encountered in recent studies are being carefully addressed [43, 44].

Murphy and King [51] 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. In the case of the Hush City app, to guarantee data quality to some extent, NoiseTube's app libraries have been implemented for sound pressure level calculation and calibration [50]. Then, the ability of the Hush City app to calculate noise at different sound pressure levels (*e.g.* background, 40 dB, 50 dB, 60 dB, 70 dB) was tested by developing a calibration procedure, as recommended by [51]. 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 (L_{aeq}) 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. Even though for getting more credible results, calibration tests should be done with the Hush City app on different smartphones, in the framework of the "open source soundscapes" methodology this weakness can be considered a minor one, given the scarcity of quiet oases embedded in the fabric of big cities characterized by sound pressure levels below 45 dB(A).

Moreover, the Hush City app is not intended to substitute professional noise meters: it is conceived to enable the collection of mixed data, which can give useful indications about places that people feel as quiet spots in cities. More

accurate and precise noise level measurements and psychoacoustic analyses can be then collected in these spots, when required, and once people identify them.

In regard to data quality, ISO norms were released to allow for the production of standardized data and the development of consistent comparative studies in soundscape research. However, with the increasing development and use of low-cost and digital new technologies (*e.g.* sensors, augmented reality, artificial intelligence, mobile apps), standardization processes face new challenges and open questions, which still have to be extensively explored. Is it possible and does it make sense to standardize the implementation of these new technologies in soundscape research? And how can this goal be achieved? How can the exponential speed of new technology development be combined with the inherent slowness of ISO norm production? How to deal with these open questions is challenging: perhaps reflections can be provided, by taking inspiration from trends occurring in citizen science [70] and in the open data movement.

5 Future work and conclusion

This contribution outlines the "open source soundscapes" methodology, which combines the soundscape approach, the citizen science paradigm and a novel mobile application – the Hush City app, with the goal of involving people in identifying, assessing and planning "everyday quiet areas" in cities. This methodology has been implemented in the framework of the "Beyond the Noise" project, by means of a citizen-driven pilot study conducted in the Reuterkiez, a Berlin neighbourhood affected by noise pollution and high levels of environmental injustice.

The Hush City app constitutes one of the outputs of the "Beyond the Noise" project, along with the "Reuterkiez Everyday Quiet Areas Master Plan" [20], which will be produced in the planning phase of the project (January 2018 – March 2018) in order to offer indications about the protection of the existing quiet areas identified by the participants in the project.

Grounded on the notion of "quietness as a commons", the "open source soundscapes" methodology can effectively contribute to the development of environmentally and socially just urban planning processes, in the city of Berlin and beyond. In this regard, technology certainly plays a key role, yet, as Cedric Price suggested, only as an enabler of people-centred urban design and planning processes.

We would like to conclude this contribution, by reminding that people-centred theories were developed as alternative to the "functional city" already in the Sixties [25, 71, 72]. The pioneer urbanist Kevin Lynch, for instance, in his seminal book "A Theory of Good City Form" [73] laid out a theory for the "good city" based on five "performance dimensions" and two meta-criteria, namely: vitality, sense, fit, access, control, and efficiency and justice. Among these performance dimensions, "sense" – to be intended as "the match between environment, our sensory and mental capabilities, and our cultural constructs" ([74], p. 118) – is the most overlooked and misunderstood one in the framework of the legacy of Kevin Lynch [25, 72]. Reconsidering the "sense" and valuing the potential of this Lyncheon criterion in the definition of the "smart city" might lead to a better understanding of how to achieve people-centred practices. In fact, paraphrasing Lynch, anyone [seems to] know what a [smart] good city is. The only serious question is how to achieve it. Should such value questions continue to be taken for granted?

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The pilot study in the Reuterkiez (Berlin) has been conducted in collaboration with Rabea and Dominik of the Stadtteilbüro Reuterkiez.

The Hush City app's software development was curated by Dr. Martin Memmel, Head of the QUERTEX GmbH, in cooperation with EdgeWorks Software, Ltd. The Hush City's mock-up was developed by QUERTEX GmbH, in cooperation with EdgeWorks Software, following an initial concept provided by Antonella Radicchi.

The Hush City app's icon was designed by Dr. Antonella Radicchi.

The acoustic consultants involved in the project are: Dipl. Ing. Michael JáckerCüppers (DEGA, Technical University of Berlin), Dipl. Ing. Manuel Frost (Berlin Senate, Senate Department for the Environment, Transport and Cli-

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