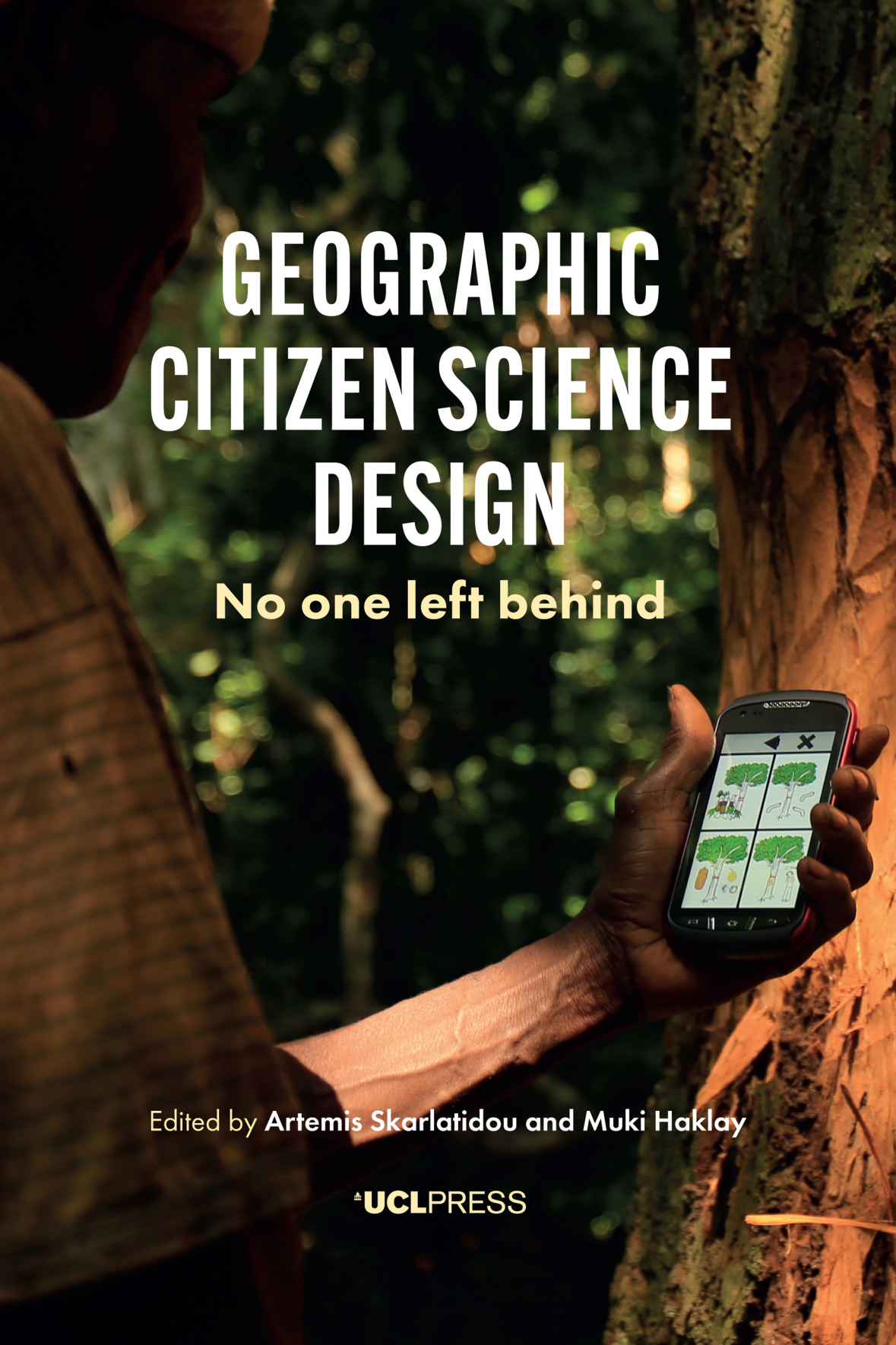

GEOGRAPHIC CITIZEN SCIENCE DESIGN

No one left behind

Edited by **Artemis Skarlatidou and Muki Haklay**

UCLPRESS

Geographic Citizen Science Design

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Contents

Introduction

Chapter 6

Citizen science mobile apps for soundscape research and public spaces studies: lessons from the Hush City project

Antonella Radicchi

Highlights

- Mobile apps have been increasingly developed as participatory tools within the context of citizen science projects on environmental noise. However, fewer apps for the combined identification and assessment of quiet areas have been developed.
- Public quiet areas can be essential for healthy cities, being key to counterbalancing the detrimental effects of noise pollution on human health, biodiversity and the environment.
- The free citizen science Hush City app, released in 2017, enables users to create an open access map of quiet areas, with the potential of orientating plans and policies for healthier living.
- Drawing on the experience of the Hush City app, 15 people-centred recommendations are proposed potentially to inform the design, build and use of citizen science mobile apps in soundscape research and public spaces studies, aimed at generating a greater health-related quality of life.

1. Introduction

According to the latest trends in European urbanisation, most European cities are expected to grow and cover greater areas than in the past, and they will likely have to deal with an increase in global environmental

issues, such as noise pollution (Vandecasteele et al. 2019). Noise constitutes the second most harmful environmental stressor in Europe, affecting more than 125 million people every year (EEA 2014). Long-term exposure to noise can affect environmental biodiversity, have detrimental effects on health (WHO 2018) and have a high cost for society (WHO 2011).

In 2002, the Environmental Noise Directive (END; EC 2002) was released with the aim of establishing a common methodology among member states to reduce noise pollution. One of the noise reduction measures introduced by the END is the creation of a plan for quiet areas in open country and agglomerations. The importance of protecting quiet areas in cities has also been recently suggested by the World Health Organization (WHO 2018). Indeed, access to quiet areas can provide benefits to health and well-being by facilitating restoration, improving concentration, favouring good sleep quality and boosting mental health (Öhrström et al. 2006; Gidlöf-Gunnarsson, Öhrström and Öhrgren 2007). Furthermore, as Rowcroft et al. (2011) suggest, access to quiet areas brings direct and indirect economic benefits, for example by saving on health costs and increasing worker productivity. But how can quiet areas be identified so as to be protected?

As sound is both a subjective and objective phenomenon, the literature recommends the adoption of qualitative criteria, in line with the soundscape concept (Schafer 1977; ISO 2014), to compensate the limits which emerged from the application of quantitative criteria to identify quiet areas in urban contexts (EEA 2014). The application of the soundscape approach to the identification of urban quiet areas implies studying the way the acoustic environment in context is perceived, experienced and/or understood (ISO 2014). However, applying the soundscape approach to identify urban quiet areas opens up further questions. How can we involve people in the identification and evaluation of urban quiet areas? How can we access and share people's knowledge about finding quietness in cities?

Against this backdrop, this chapter presents the Hush City app, which was developed as a citizen science tool to address these open questions, within the context of a more comprehensive framework (Radicchi 2017b; 2019). First, Hush City's rationale (Section 2) and its mapping interface (Section 3) are described. Then, benefits and barriers experienced by Hush City users are illustrated, followed by how they can be exploited in future development of the app (Section 4). In conclusion, an original framework of 15 people-centred recommendations is proposed to inform the design, build and use of citizen science mobile apps for soundscape research and public spaces studies aimed at generating a greater health-related quality of life (Section 5).

2. The Hush City app

2.1 Rationale for the development of a citizen science app to map and assess quiet areas

The Hush City citizen science mobile app was envisioned to address an issue framed at the European environmental policy level (EC 2002; WHO 2018): how to identify and map urban quiet areas properly so as to protect them by applying the soundscape approach.

The idea of developing a citizen science mobile app emerged from studying the literature. Trends in citizen science were observed regarding the practice of involving citizens in addressing open questions in science by exploiting mobile apps (Haklay 2016; Hecker et al. 2018; Luna et al. 2018). First, a review of the existing mobile apps developed for environmental noise assessment was conducted. Since 2008, 28 mobile apps have been developed, but none of them could be used by people to map and assess quiet areas specifically by collecting mixed data (Radicchi 2017a; 2017c; 2018). Therefore, Hush City was developed with the aim of addressing the following goals on multiple levels:

- Participation: exploiting mobile technology to favour citizen engagement in the planning and policy process;
- Science: helping scientists understand what people value when they search for quietness in cities;
- Policy: validating a participatory methodology to identify and map quiet areas in cities so as to protect them;
- Health and well-being: helping people find places to recover from sensory overload, by creating an open access web-based map of urban quiet areas; and
- Education and civic awareness: inducing self-reflection on the impact of noise on health and biodiversity and the importance of protecting quietness.

2.2 Identifying Hush City users

When Hush City was under development in 2016, there was no target core group of users with whom to co-design and test the app. To overcome this potential weakness, colleagues and friends were invited to test the app and provide initial feedback. The design principles learned by the author during participation in the workshop organised by the European Citizen Science Association in Berlin in the autumn of 2016 were also used as a reference (Sturm et al. 2018).

A user analysis was then performed during the first two years after the launch of the Hush City mobile app. From this user analysis, six types of Hush City users were identified. The general public constitutes the core group of users. Activist groups concerned with ecological and environmental issues use the app to evaluate and monitor the quality of public spaces in their communities. Local municipalities in charge of developing and updating their Plan of Quiet Areas every five years (according to the END) are also users of Hush City; they are also potential partners for the project, as in the case of the municipality of Berlin within the context of the Berlin Plan of Quiet Areas 2019–23. Researchers and academics also constitute a core group of users. They can use the data collected with the Hush City mobile app to understand better what people value when they search for quietness in cities and to investigate similarities and differences related to context variation (Radicchi and Vida Manzano 2018). Finally, the media and journalists represent an important group of actors who help raise and retain the participation of the public, and build awareness about the importance of living in places of high (acoustic) quality.

3. The Hush City app: concept, interface and technology

Hush City is a novel and free citizen science mobile app, launched in April 2017 to enable people to map, evaluate and discover public quiet areas. A second version of the Hush City mobile app, available in four languages (English, German, Spanish and Italian), was released in June 2018, along with the web-based version of the app. The mobile version of Hush City is available for both Android and iOS, and both the mobile and the web-based version of the app are free to use.

The mobile version of the Hush City app was developed to allow for the in situ mapping of quiet areas and the collection of data related to these quiet areas. The web-based version of Hush City was also developed to make the data accessible to those who might not own a smartphone but are nevertheless interested in exploring the quiet areas crowdsourced via the Hush City mobile app.

Innovative aspects of the Hush City app relate primarily to data collection. By using the Hush City mobile app, both qualitative and quantitative data related to the quiet areas can be crowdsourced through a data-collection process articulated in four sequential steps. First, users record a 30-second audio recording, and then they calculate its sound pressure levels. Next, they take a picture of the quiet area where they are, and lastly, they reply to a questionnaire (Figures 6.1 and 6.2). After completion of the four data-collection steps, users can submit the data, which

is then linked in real time to the open access web-based map. The questionnaire is composed of 20 predefined questions (Table 6.1), which relate to the multifaceted factors influencing the environmental experience (Herranz-Pascual, Aspuru and García 2010). The questionnaire and the reply options were designed in 2016, prior to the release of the 2018 ISO norm on data-collection methods for soundscape (ISO 2018), referring to established questionnaires used in previous soundscape and quiet areas studies (e.g. Carfagni et al. 2014).

After the submissions of the data sets through the mobile app, data are geo-referenced and time stamped in real time to the Hush City Map, which is available via both the mobile and the web-based version of the app (Figures 6.1–6.3).

3.1 Hush City mobile app: interface design concept

The interface design concept of the Hush City mobile app has been designed to favour a user-friendly experience. After accessing the home page, users are offered two options. They can start mapping and evaluating the quiet areas by clicking on the button 'Map the quietness around you', and they can discover quiet areas crowdsourced by other users in their city or worldwide by clicking on the button 'Quiet Areas' (see Figure 6.1).

On the home page, there is also a menu which allows users to return to the home page at any point, consult and eventually delete their own data submissions, access the list of the monthly 'Hush City Ambassadors' and manage their account settings (e.g. they can change their password, select the language, provide feedback on the app, close their account and so on).

In detail, the 'Hush City Ambassadors' feature was introduced in the second version of the Hush City app, in 2018, to set up a rewarding mechanism to motivate users and retain participation. When users map and share quiet areas, they enter a list of 'Hush City Ambassadors' which is updated monthly. At the end of the month, users get a pop-up message, notifying them that they have been nominated 'Hush City Ambassador of [name of the city]', and they can choose whether they want to have their name featured in the Hush City's monthly newsletters and on the Hush City Ambassador web page.

Additional home-page features include a 'Localizer icon', which indicates the user's position on the map while using the app. By clicking on it, users can refresh and double-check their geographic position before starting the mapping and data-collection process. A search button ena-

Table 6.1 Reporting the questionnaire in English embedded in the Hush City mobile app

Q no.	Questions	Reply options
1	What prompted you to record this sound?	*Multiple choice and open entry* Pleasure |-| Comfort |-| Irritation |-| Distraction |-| Happiness |-| Sadness |-| Calm |-| Anger |-| Nostalgia |-| Anxiety |-| Surprise |-| Shame |-| Fun |-| Disgust |-| Boredom |-| Interest |-| Other
2	In which category would you place this sound?	*Multiple choice and open entry* Human voices |-| Human movement |-| Natural elements |-| Animals |-| Vegetation |-| Construction |-| Ventilation and electronics |-| Motorised Transport |-| Non-motorised transport |-| Social/signals |-| Music |-| Other
3	Using the words given below, please describe the sound you recorded.	*Multiple choice and open entry* Lively |-| Boring |-| Familiar |-| Unfamiliar |-| Stressing |-| Relaxing |-| Meaningful |-| Meaningless |-| Pleasant |-| Unpleasant |-| Informative |-| Uninformative |-| Preferred |-| Unpreferred |-| Natural |-| Artificial |-| Friendly |-| Unfriendly |-| Beautiful |-| Ugly |-| Other
4	Rate how quiet the soundscape is in this location.	*Five-point linear scale* Not quiet–very quiet
5	Enter the sounds that contribute in a positive way to your sense of quietness in this location.	*Open entry* Free text
6	Enter the sounds that disturb your sense of quietness in this location.	*Open entry* Free text
7	To what extent do the sounds in this location promote social interaction?	*Five-point linear scale* Not much–very much
8	To what extent do the sounds in this location encourage you to have conversations here?	*Five-point linear scale* Not much–very much

(*continued*)

Table 6.1 (continued)

Q no.	Questions	Reply options
9	Can you hear other people's conversations around you?	*Dual scale* Yes/no
10	Enter the sounds that contribute to the identity of this place.	*Open entry* Free text
11	Are there people around?	*Multiple choice* No one |-| A few |-| Many
12	What are people doing here?	*Multiple choice and open entry* Passing through |-| Working |-| Relaxing |-| Recreationing |-| Waiting |-| Reading |-| Talking |-| Listening to music |-| Playing |-| Other
13	Personal information regarding where the user lives.	*Multiple choice and open entry* I live in this area |-| I work in this area |-| I live in this city, but not in this area |-| I am a tourist |-| Other
14	How is the weather?	*Multiple choice and open entry* Windy |-| Snow |-| Rainy |-| Humid |-| Foggy |-| Sunny |-| Cloudy |-| Stormy |-| Dry |-| Icy |-| Warm |-| Cold |-| Clear |-| Hot |-| Calm |-| Other
15	Rate the overall quality of this location.	*Five-point linear scale* Not good–very good
16	Rate the overall cleanliness of this location.	*Five-point linear scale* Not good–very good
17	Rate the overall maintenance of this location.	*Five-point linear scale* Not good–very good
18	Rate the feeling of security in this location.	*Five-point linear scale* Not good–very good
19	Rate the overall accessibility to this location.	*Five-point linear scale* Not good–very good
20	Please add your additional comments and thoughts in the blank space below.	*Open entry* Free text

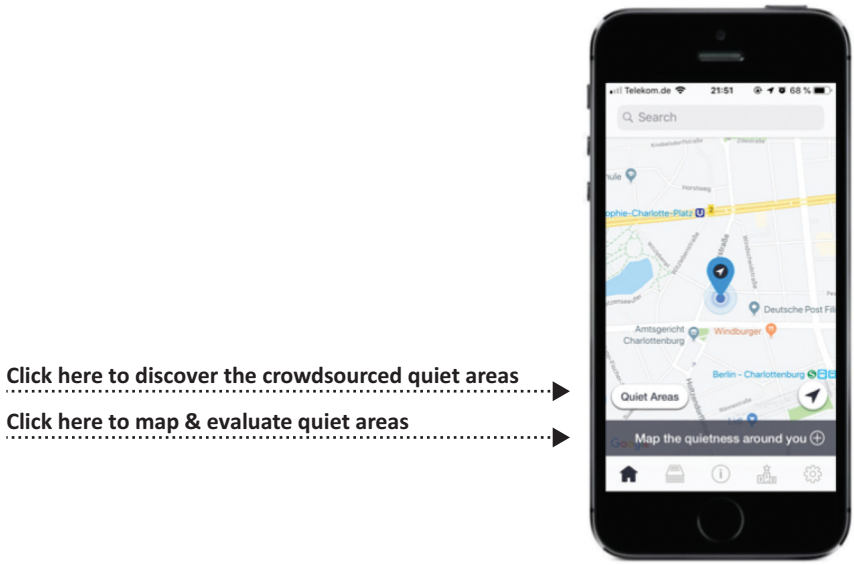

Fig. 6.1 Interface of the Hush City mobile app. © Antonella Radicchi 2017. Basemap © Google Maps.

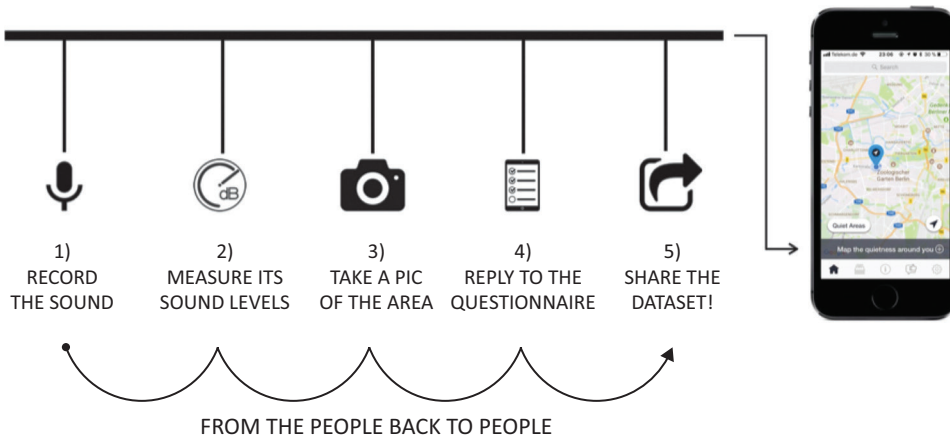

Fig. 6.2 Concept of the Hush City mobile app data-collection process. © Antonella Radicchi 2019. Basemap © Google Maps.

bles users to search for geographic areas and be directed to the city where they are located or to other cities around the world. In the 'Quiet Areas' mode, which can be activated by clicking the button, the background map turns to black, and users can access three additional features: 'Legend', 'Filter' and 'List View'.

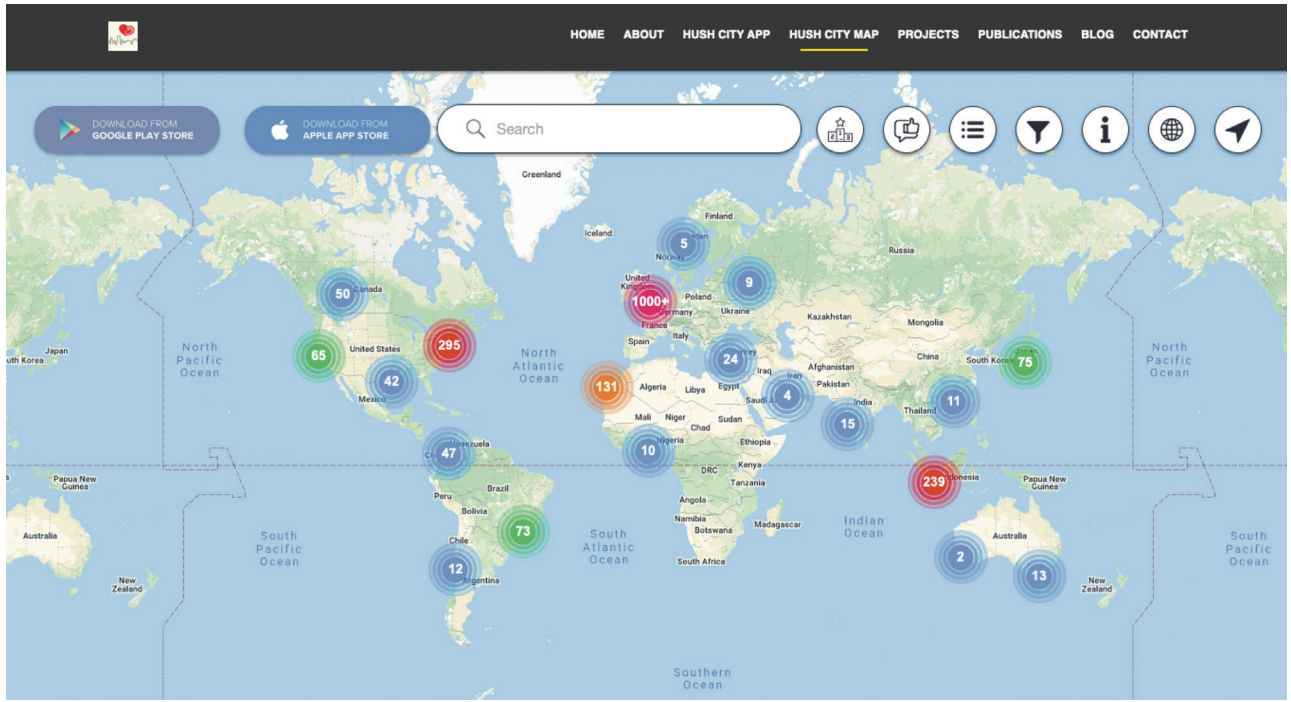

Fig. 6.3 Hush City Map as displayed on the web-based version of the Hush City app. © Antonella Radicchi 2020. Basemap © Google Maps.

'Legend' informs users about the meaning of the markers' colours and the numbers embedded in the markers displayed on the map. The colours refer to the sound pressure levels measured by the Hush City app, whereas the numbers displayed on the markers refer to the numbers of data sets collected on the same quiet area. This feature was provided with the aim of giving users the possibility of collecting more data sets in the same quiet area and monitoring the status of the quiet area over a certain period of time.

'Filter' allows users to filter the quiet areas according to several parameters, such as sound levels, semantic descriptors, perceived quietness, visual quality and accessibility. These parameters can be selected individually or in combination. For example, users can find those quiet areas which are perceived as very quiet and accessible by setting the respective parameters and activating the Filter feature. The quiet areas can also be sorted by 'Number', 'City' and 'Noise Levels', and displayed in ascending or descending order by accessing the 'List View' feature. This feature was implemented to facilitate the screening and browsing of quiet areas via smartphones.

3.2 The Hush City mobile app: data-collection interface concept

To initiate the mapping and assessing of quiet areas, users in a quiet area can access the mobile app and click on the button 'Map the quietness around you' displayed on the home page (see Figure 6.2).

Users are then invited to take an audio recording of the quiet area, which after 30 seconds automatically stops. They then measure the sound levels by clicking on the button 'Analyse'. Afterwards, the app displays the weighted sound pressure levels of the sound recorded as: L_{eq} (equivalent continuous sound level), L_{min} (minimum sound level) and L_{max} (maximum sound level). After that, users take a picture of the quiet area where they are, and then they evaluate the quiet area by replying to the questionnaire (see Table 6.1). After the completion of the questionnaire, users can review the data set and choose whether to submit the data set.

3.3 Hush City web-based application: interface design concept

The web-based version of the Hush City app displays the quiet areas crowdsourced worldwide via the Hush City mobile app; it does not allow for mapping and assessing quiet areas. Users can access the home-page features to filter the quiet areas and visualise them through the 'List View' mode. Users can also select the language they prefer from Italian, Eng-

lish, German, Spanish and Portuguese. They can also obtain information on the project and provide feedback on the Hush City app.

As of July 2020, the Hush City Map, accessible through the mobile and the web-based version of the app, contains more than four thousand quiet areas crowdsourced by more than five hundred users in different cities around the world (see Figure 6.3).

4. Interacting with the Hush City app: benefits and barriers

Data collection through mobile apps is usually unsupervised in nature, which does not necessarily affect the effectiveness and capability of such apps to produce reliable, consistent and accessible data (Theunis, Stevens and Botteldooren 2017). Nevertheless, how the apps are built and designed is key to addressing a mobile app's data reliability. Consequently, in the process of designing and building the Hush City mobile app, recommendations discussed in the citizen science literature (Luna et al. 2018) were taken into account, especially regarding interoperability, participant-centred design and agile development, user interface and experience design, and users' motivational factors.

As a result, was Hush City able to meet the needs and fulfil the expectations of its users? What benefits and barriers did Hush City users encounter using the app? Which features would they recommend to improve it? How do Hush City users interact with the app?

To answer these questions, Hush City users' feedback received over the past two years via the mobile and web-based versions of the app, paper forms and a survey conducted via MonkeySurvey tool was analysed using a qualitative approach to data synthesis.

For the purpose of this chapter, users' feedback will be presented so as to highlight whether and to what extent the questionnaires which are used to enable data input are helpful for interaction design and, if so, how these can inform the future of geographic citizen science app design. The chapter also explains how the lessons learnt from Hush City users' feedback will inform potential future improvements of the app.

Regarding the app rating – provided by users through the web-based app, iTunes and Google Play stores, and the survey – the results show that 51 out of 81 users rated the app with four or five stars. Although software developers are usually interested in this kind of rating, in my role as Hush City inventor and principal investigator, I find such ratings

informative yet not explicative of the reasons which lead users to rate the app positively or negatively.

In terms of user behaviour, the results show that there are two distinct group of users: 'one-session' users who installed the mobile app only to use it once and/or to test it, and 'long-term' users who use the mobile app on a regular basis, for example several times a week, several times a month, monthly and/or when the occasion arises. This pattern is in line with trends that emerged in mainstream citizen science projects according to Seymour and Haklay (2017). The majority of Hush City users almost never share the data collected with Hush City app via social media, although this function is embedded in the mobile and web-based versions of the app. This result can be used to implement new features to encourage data sharing via social media, for example by embedding in the app 'pop-up messages' and/or a short video explaining the feature and its rationale.

From the analysis of the results, it also emerged that the majority of user-experience problems are related to unstable and unreliable Internet access, Internet cost and app crashes (the latter especially occurring on smartphones running on Android OS). This limitation can be addressed, giving the users the possibility to collect data offline and upload them when Internet access is established.

Other barriers highlighted by the Hush City users refer to the questionnaire embedded in the mobile app (Table 6.1). Some users find the questionnaire too long, while others find it annoying not having the option to skip questions. This is a critical point, which was extensively discussed when the first version of the mobile app was under development in 2016. The discussion indeed revolved around whether to provide users with the option to skip the questions. Ultimately, it was decided to make replying to the questionnaire mandatory, so as to collect consistent data which can be used for research purposes.

Some users also suggested creating a webspace for engagement and discussion (i.e. a forum). A few others recommended improving the mobile app's readability by increasing the font size of the text and implementing a kind of a 'sunscreen feature', so that the mobile app is more easily accessible when used outdoors in extreme light conditions. One user suggested making the mobile app more interactive by implementing 'filters that can block the noise of traffic, just to see how quiet a place can be without these factors in real time'. All these comments and recommendations are valuable, and they can be implemented in future versions of the app, depending on the financial budget. Among them, creating a

webspace for discussion and improving the readability by enlarging the font will be the easiest to implement.

Along with user recommendations for future improvements, it is equally important to account for the features the users like the most and to consider them in future steps. The majority of users most like the mobile app's functionality and the way it looks and feels. The mobile app's 'user-friendliness' was appreciated by the users in the New York soundwalks (Radicchi 2019), with one user commenting that 'the app and the approach [were] useful and helpful in understanding the importance of subjective environmental acoustic awareness'. The Hush City mobile app was also defined as a tool 'that could be used to be part of a social change' and 'a good [one] for children too'. Positive feedback also related to the research idea behind the app, that is, giving people the ability to find quiet places and map them. This feature is particularly appreciated by one user who is the parent of an autistic child, who 'find[s] the app a great tool to find quiet places if [their] son is having a meltdown'. This comment can be used to implement pop-up features which recommend to users the quiet areas crowdsourced by other users in the city where they are. For example, pop-up notifications can be implemented to notify the users when they are in the proximity of a quiet area. This feature can only be operationalised if users consent to share their position with the app.

Since its launch in April 2017, public interest in the Hush City app has grown, and the crowdsourcing process, initiated by the author in 2017 within the context of a pilot study in a Berlin neighbourhood, has spontaneously scaled up the app to the worldwide level. Today, Hush City can count on an international community of engaged citizen scientists who have crowdsourced quiet areas from different countries, spanning from Europe to America to Asia.

5. People-centred recommendations for soundscape and public spaces studies

This chapter has presented Hush City, a novel free citizen science mobile app, launched in April 2017 to address an open issue in European environmental policy: how to enable people to map, evaluate and discover public quiet areas. First, Hush City's rationale along with the mobile and web version of the app were introduced. Then, benefits and barriers experienced by the Hush City users were illustrated to explain how users'

feedback can be exploited in the future development of the app. In conclusion, an original framework of 15 people-centred recommendations (Table 6.2) for the design, build and use of mobile apps for soundscape research and public spaces studies is presented. In detail, recommendations 1–4 are drawn from a framework developed in citizen science by Luna et al. (2018), whereas recommendations 5–15 are an original contribution by the author (Table 6.2).

First, it is of paramount importance to ensure that citizen science mobile apps are accepted among society at large by favouring their discussion and negotiation in complex decision-making processes among different actors and the public (Königstorfer and Gröppel-Jlein 2012).

To place the user at the centre of the design process is also recommended, by involving the participants in the design of the citizen science mobile app, possibly in each step of the project (from start to end). Considering and incorporating motivational factors is then relevant to elicit and retain participation in order to ensure successful utilisation of the apps and also sustainability. In the case of the Hush City project, for example, the most active participants are publicly acknowledged and nominated as 'Hush City Ambassadors' of the cities where they have been active in crowdsourcing quiet areas.

Other key recommendations include strategies for favouring knowledge dissemination generated by the use of citizen science mobile apps. To this end, communication and data representation are key factors to account for, which can be achieved by building user-friendly digital dashboards and maps which enable interaction with users. Knowledge sharing can also be favoured by creating open access web-based repositories where data collected via citizen science mobile apps can be accessed by stakeholders and society at large and used within the context of bottom-up integrated urban planning. Also, ensuring that data collected via the mobile apps are open access and linked to open web-based platforms can contribute to data democratisation (Morozov and Bria 2018) and to novel forms of multilevel governance.

These 15 recommendations are informed by the citizen science literature and the author's experience gained through the Hush City app development and implementation over the past three years. In sharing them, it is hoped that they can inform and orientate the design, build and use of citizen science mobile apps for the collection of reliable and consistent data which can be used within the context of soundscape research and public spaces studies, aimed at generating a greater health-related quality of life.

Table 6.2 Framework of 15 people-centred recommendations for the design, build and use of citizen science mobile apps for soundscape and public spaces studies

1. **Ensure interoperability**: e.g. ensuring data quality, data sharing with the participants, data reuse though CC licenses, data privacy.
2. **Place the user at the centre of the design process**: e.g. involving the participants in the design of mobile apps at each step of the projects (start to end).
3. **Follow a user experience design**: e.g. using 'effective and efficient' design elements (e.g. icons, arrows, etc.) to guide participants through the data-collection process.
4. **Consider and incorporate motivational factors**: e.g. bringing relevant motivations for participation to the foreground, addressing the 'six motivational categories'.
5. **Ensure the app is accepted among society at large**: e.g. favouring the negotiation of technological innovation, such as mobile apps, in society and complex decision-making processes among different actors (Königstorfer and Gröppel-Jlein 2012).
6. **Curate data representation to facilitate communication and user interaction**: e.g. exploiting interactive data-representation techniques to build user-friendly digital dashboards and maps.
7. **Enable communication and interaction with the users**: e.g. training academics and professional in innovative dissemination and communication techniques, referring to trends in citizen science and media and communication studies.
8. **Favour in situ and context-based assessment**: e.g. exploiting mobile apps to allow for in situ perceptual evaluation, fulfilling the definition of the landscape (EC ETS 2000) and soundscape (ISO 2014) concepts.
9. **Encourage intimate sensing–related practices**: e.g. implementing mobile apps as a means to favour the return to an intimate sensing of places, counterbalancing place detachment inducted by trends in remote sensing (Porteous 1990).
10. **Boost extreme participation**: e.g. designing citizen science mobile apps so as to help move from an information/consulting level of participation to a new one where citizens can control and act from the beginning of the process (Arnstein 1969; Haklay 2016).
11. **Raise environmental awareness**: e.g. including information about the projects in the mobile apps to raise awareness of the importance of living in healthy environments.

Table 6.2 (continued)

12. **Make data open access**: e.g. ensuring that data collected via the mobile apps is open access and linked to open, web-based platforms, contributing to data democratisation (Morozov and Bria 2018) and to novel forms of multilevel governance.
13. **Enhance data collection and mapping**: e.g. exploiting data collection and mapping via mobile apps to complement traditional mapping methods.
14. **Favour bottom-up, integrated urban planning:** e.g. creating open access, web-based repositories where data collected via mobile apps can be accessed by stakeholders and society at large.
15. **Develop comparative scientific interdisciplinary studies and inter-sectoral projects**: e.g. designing data-collection processes via mobile apps so as to obtain reliable and consistent data which can then be used for comparative scientific studies and inter-sectoral projects.

6. Lessons learned

- The involvement and retainment of participation is key to the successful implementation of citizen science projects. It is recommended that training courses in communication and social media management become part of academic and professional curricula, and communication skills are acknowledged as added values for scientists.
- The use of mobile apps as participatory tools for data collection, mapping and sharing has not yet been fully accepted, especially among academics and public officials, although the majority of the mobile apps for environmental noise assessment released between 2008 and 2018 have been developed within the context of academic and inter-sectoral projects. It is recommended that the reliability of technological innovations such as citizen science mobile apps is discussed further within society at large and with different stakeholders.
- Empirical evidence gained through Hush City project shows the potential and benefits of exploiting mobile apps as participatory tools within the context of soundscape research, public spaces studies and planning for healthy cities. It is advisable that critical issues

regarding the design, building and implementation of mobile apps are addressed by ISO norms and further investigated in future research.

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Both the aforementioned projects have been envisioned and developed by Dr Arch. Antonella Radicchi (Technical University of Berlin). Project supervisors: Prof. Dr D. Henckel (Technical University of Berlin) and Dipl. Ing. J. Kaptain (Berlin Senate, Senate Department for the Environment, Transport and Climate Protection). Soundscape adviser: Prof. Dr B. Schulte-Fortkamp (Technical University of Berlin). Acoustic advisers: Dipl. Ing. M. Jäcker-Cüppers (ALD, Technical University of Berlin), M.A. M. Frost (Berlin Senate, Senate Department for the Environment, Transport and Climate Protection) and Dipl. Ing. M. Cobianchi (Bowers & Wilkins, UK).

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Little did Isaac Newton, Charles Darwin and other 'gentlemen scientists' know, when they were making their scientific discoveries, that some centuries later they would inspire a new field of scientific practice and innovation, called citizen science. The current growth and availability of citizen science projects and relevant applications to support citizen involvement is massive; every citizen has an opportunity to become a scientist and contribute to a scientific discipline, without having any professional qualifications.

Geographic Citizen Science Design takes an anthropological and Human–Computer Interaction (HCI) stance to provide the theoretical and methodological foundations to support the design, development and evaluation of citizen science projects and their user-friendly applications. Through a careful selection of case studies in the urban and non-urban contexts of the Global North and South, the chapters provide insights into the design and interaction barriers, as well as on the lessons learned from the engagement of a diverse set of participants.

Looking at the field through the lenses of specific case studies, the book captures the current state of the art in research and development of geographic citizen science and provides critical insight to inform technological innovation and future research in this area.

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