ARCHIVIO ISTITUZIONALE DELLA RICERCA

Alma Mater Studiorum Università di Bologna
Archivio istituzionale della ricerca

Virtual Environments as Enablers of Civic Awareness and Engagement

This is the final peer-reviewed author's accepted manuscript (postprint) of the following publication:

Published Version:
Virtual Environments as Enablers of Civic Awareness and Engagement / Paolo Bellavista, Antonio Corradi, Luca Foschini, Eliza Helena Gomes, Elena Lamberti, Gisiela Klein, Carlos Roberto De Rolt, Marco Torello,. - In: INTERNATIONAL JOURNAL OF URBAN PLANNING AND SMART CITIES. - ISSN 2644-1659. - STAMPA. - 1:1(2020), pp. 2.22-2.34. [10.4018/IJUPSC]

Availability:
This version is available at: https://hdl.handle.net/11585/708124 since: 2021-03-01

Published:

DOI: http://doi.org/10.4018/IJUPSC

Terms of use:

Some rights reserved. The terms and conditions for the reuse of this version of the manuscript are specified in the publishing policy. For all terms of use and more information see the publisher's website.

This item was downloaded from IRIS Università di Bologna (https://cris.unibo.it/).
When citing, please refer to the published version.

(Article begins on next page)

20 April 2024

This is the final peer-reviewed accepted manuscript of:

Bellavista, Paolo, et al. "Virtual Environments as Enablers of Civic Awareness and Engagement." IJUPSC vol.1, no.1 2020: pp.22-34.

The final published version is available online at **http://doi.org/10.4018/IJUPSC.2020010102**

Rights / License:

The terms and conditions for the reuse of this version of the manuscript are specified in the publishing policy. For all terms of use and more information see the publisher's website.

This item was downloaded from IRIS Università di Bologna (https://cris.unibo.it/)

When citing, please refer to the published version.

Virtual Environments as Enablers of Civic Awareness and Engagement

Paolo Bellavista, Antonio Corradi, Luca Foschini, Eliza Gomes, Elena Lamberti, Gisiela Klein, Carlos Roberto De Rolt, Marco Torello

Abstract

Smart Cities are a looming reality.

The wide availability of accurate sensors, such as accelerometers, barometers, cameras and microphones currently hosted by consumers' smartphone is increasingly enabling participative urban management opportunities. Crowd-sensing allow people to actively participate in any aspect of urban planning, by collecting and sharing data, reporting issues to public administrations, propose solutions to urban planners and deliver information of social interest to their community. Traffic congestion, air pollution and public transport can be addressed by innovative sensors on fixed infrastructures and integrate with data gathered by people through mobile devices. The collected data can be very helpful to enhance the quality of life of people who live in the urban context. However, most mobile users are still reluctant to use their devices to take advantages of the opportunities offered by the digitized society: people that report issues are expecting for concrete solutions or, at least, positive feedback from the local or national governments.

From August to December 2018, in the city of Florianópolis, capital of Santa Catarina, in southern Brazil, was used a living lab environment for mobile crowdsensing application called ParticipACT Brazil. During this period, a publicity campaign showed the tool to the society and invited population to participate in the survey of urban problems, sending geo-localized reports, videos, photos and audios. The objective was testing the application's functionalities and the ability to engage society in solving collective problems in a public space. This paper explores the possibilities offered by *crowd-sensing* technologies for urban management and social environments enhancements by presenting the ongoing experiences and the results obtained within ParticipACT, a transnational and multidisciplinary project that aim at studying the still under-explored potential of collaboration among people.

Keywords: crowdsensing, engagement, participation, civic awareness

Contents

Introduction

In the last decades mobile devices are become increasingly pervasive. According to Gartner (2016) there are more than 1.4 billion smartphones sold worldwide by 2015, while Statista (2018) estimates the number of smartphone users will reach 2.87 billion by 2020. In this scenario, advances in wireless communications, smart devices provided with increasingly accurate sensors (such as accelerometers, barometers, cameras, microphones and more), and social computing applications are enabling new urban sensing and management opportunities, turning smartphones into very reliable sensing probes connected to each other through cloud servers (Cardone, et al., 2013). The entire set of available sensing methodologies and technologies has therefore made it possible to formulate a new sensing paradigm known as Mobile Crowdsensing (MCS) (Capponi, et al., 2019).

MCS rely on people willing to collaborate toward continuous data harvesting processes by exploiting sensor-rich smartphones that nowadays are sources of very valuable information. Smartphones can become part of a (large-scale) mobile sensor network by installing a crowdsensing application, partially operated by the owners of the phones themselves (Chessa, et al., 2016) and connected with a cloud server that sends *tasks* and store raw data from user smartphones. In this way, people can be called on data collection processes related to specific issues (i.e. traffic congestions, delay in public transport, lack of city services and so on), enabling virtual Community of Actions (CoA) interested in provide solutions to surrounding critical issues and participate in public utility services by sharing useful information to neighbourhoods.

At the same time, citizens can suggest solutions based on specific needs of community, allowing real-time interactions between citizenship and public administration and taking part in a virtuous process that aim to quality life enhancements for the whole city making it smarter. In this scenario, citizens are both actors and beneficiaries of a participatory system that put both individuals and communities at the centre of urban planning managements with the final purpose to speed up the settlement of city problems.

Usually, MCS can be enabled with two different approaches: *opportunistic* and *participatory*. Opportunistic sensing scenario involves users carrying mobile devices with applications running in the background, continuously collect sensors readings such GPS, accelerometers and so on (Marjanović, et al., 2018). The user activity required by the data acquisition processes are minimal and the collected data are mostly homogeneous, very specific and therefore, easy to analyse. Opportunistic sensing is a mostly passive activity which do not involve much of user awareness.

Participatory sensing, instead, requires active involvement by both administrators and users in a double intervention: on the one hand the admin must start a campaign in which it defines the tasks to be performed by the user; on the other the user must enable sensors readings on a specific target. In the case of participatory sensing the active participation of people is subordinated to actions on the mobile devices and requires willingness and consent, which implies high level of civic awareness regarding the surrounding environments and a knowledge of the issues that affect the local community. In this paper, we will mostly focus on participatory sensing processes.

The data collected through participatory sensing processes are heterogeneous and subject to variance in user perceptions: as human beings, perception of problems changes according to education, experiences, personal interests and level of civic awareness. The definition of target groups in MCS campaign is crucial to achieve a specific goal and the MCS administrator must take into account all the variables that may affect the final result, adapting campaigns and tasks to the desired target. For example, a campaign that focus on the quality of the canteen services in a school must take into account that the target is mostly composed by young people which requires different stimulus to stimulate survey participations (Nie, et al., 2018). A widely adopted approach is to apply *gamification* techniques and that has been widely explored in many papers that proposed it as definitive solutions to encourage sensing participation activities, affecting heavily the entire democratic society in way never experienced before. Gamification aims to provide some sort of "reward" that can encourage MCS users to participate in the data collection and, at the same time, gain "benefit" for themselves.

In fact, as it was explored in the literature, people participation in MCS activities aimed to provide issue reports is subordinate to feedback receptions from administrators. In the case of urban crowdsensing – i.e. traffic congestion or road maintenance issues – citizen expect a response to their effort from the public administrators. In absence of feedback – positive or negative – even the most inclined users lose interest in participating crowdsensing processes (Nie, et al., 2018). To stimulate and recruit users with mobile devices to participate in Crowdsensing, the Crowdsensing Service Provider (CSP) usually provides a reward for the users as monetary incentive. However, gamification can be a source of false information produced by selfish behaviours, such as favouring an individual rather than for the collective benefit. For this reason, the primary target of MCS paradigm are large crowds in order to provide more sources and ensure data reliability while reducing the possibility of false information that could affect negatively the community (Bellavista, et al., 2018).

In a broader sense, participatory sensing fosters new forms of social interactions between people by promoting collective engagement in virtual environments that replicate the urban ones and obviously, it must be taken into account that the results of a MCS survey – as any kind of survey that rely on human beings – can be subjected to falsifications (deliberate or accidentally) and barriers of social acceptance.

In addition to those social barrier, the existing literature also highlights the technical barriers related to heterogeneity of sensing hardware, mobile platform and software applications (Xiao, et al., 2013). For example, the impossibility to run the same application on different mobile platform (Android, iOS, Windows and so on) affects the diffusion of crowdsensing application even in the same neighbourhood, reducing significantly CoAs effectiveness. Moreover, hardware differences between sensors provided within smartphone of different brands may affect the reliability of collected data. Finally, an MCS application can generate conflicts with other sensing software running on the same devices, affecting mobile performances and battery lifetime. Battery consumption and communication costs are part of citizens concerns and discourage participation to crowdsensing actions.

Finally, another main cross-cutting concern, both social and technical, is (data) privacy. That is partially linked to the lack of willingness of individuals to associate themselves in small CoA to face and solve problems – in few words, lack of civic responsibility – and that is an issue that can be hardly solved by technicians.

For address all above issues, in this paper the authors will highlight the unexpressed potentiality of civic awareness in mobile crowdsensing processes by exposing the results of ParticipACT Brazil, a crowdsensing experiment in Florianopolis, Brazil. In the first section a technical and socio-cultural background related to Mobile Crowdsensing will be introduced. The second part will highlight the seminal expected results of the ParticipACT experiment in the Brazilian area of Florianopolis while the last section will introduce the ongoing research directions related to Mobile Crowdsensing methodologies.

Background

Civic engagement through ICT technologies

The 1990s and 2000s are known by changes in the pattern of political citizenship in Western democracies. The ability to send and receive messages instantly in different formats allows forms of engagement and virtual participation that differ from those in physical environments.

Some empirical investigations have sought to identify which factors influence citizens' engagement in political and social causes. Structural aspects of the state and society, such as socioeconomic development and political and social institutions; and individual attributes linked to material resources and motivations have been combined in different ways in researches to understand the constraints of activism (Borba & Ribeiro, 2010; Norris, 2002).

In the virtual environment, there are four strands mapped in engagement studies – cyber-optimists, cyber-pessimists, cybernetics and multidirectional visionaries (Norris, 2001). For the first group, the Internet created communication structures and, consequently, new opportunities of participation substantially different from the participation in the offline space. The network would have the power to reduce some barriers to participation, especially in relation to time and access to information, which would broaden the public sphere. In brief, for cyber-optimists the Internet is capable of mobilizing individuals who did not mobilize and strengthen democracy (Norris & Curtice, 2006; Xenos & Moy, 2007).

Among cyber-pessimists, instead, claim that Internet reinforces the structures that have already been put in offline place. The network would not be able to arise the political interest, and, in this way, the online activism is a mode of participation for those that are already engaged in the offline world. For the cyber-pessimists, the new information technologies would not have the capacity to transform society and would act in the sense of deepening existing social cleavages (Norris, Norris & Curtice, 2006). Under this explanatory model, new information and communication technologies simply bring new opportunities to the already active citizens (Norris, 2001). An even more radical group than the cyber-pessimists are the cybernetics for whom cyberspace only reproduces politics as usual, without eliminating or deepening existing social cleavages (Norris, Norris & Curtice, 2006).

In a multidirectional view, the question of engagement can be approached in a macro dimension, considering the structures of the state and society, and in a micro dimension, focused on individual resources and motivations (Best & Krueger, 2005; Hafner-Fink & Oblak Črnič, 2014, Norris, 2001). In this approach, the fact that the individual has access to the smartphone and data plans, for example, is crucial to facilitate online participation.

Pippa Norris (2001) has developed an online engagement model in which participation is a result of the combination of technology and its interactive particularity, socioeconomic environment and virtual political system that reflect offline world and uses the conventional system as a model. The author also argues that, because of the great weight of individuality, the political use of network could be either revolutionary or could reinforce it. It is revolutionary as it presents itself as a space in which new social movements can strengthen and exert influence on the values and attitudes of society. However, the use of network depends directly on the individual and, in this sense, in the first moment the web is reinforcing, because it is the individual tastes and preferences that guide the use. Consequently, they are two movements executed by cyberspace that can reinforce the structures and values consolidated, but also serve as a means of contestation of structures and change of values (Norris, 2001).

For the Latin American context, the work of Schegel (2009) presents the profile of the Argentine, Brazilian and Chilean Internet users in terms of participation and political values, using data from the Latinobarómetro of 2007. In particular, the author proposed to analyse the impacts of sociodemographic, behavioural characteristics, associativism and exposure to traditional media in regular access to the Internet. According to the study, the Brazilian Internet user is more educated, younger, interested in politics, sports, leisure or cultural associations and has a habit of reading newspapers. In Argentina's case, the Internet user has higher educational levels, higher income and is a managerial worker. Membership in trade unions and exposure to traditional media, radios and newspapers specifically, are also influential on the regular use of technology. In the case of Chile, more educated, wealthier, younger individuals who work in managerial positions, whites and politicians are more likely to use cyberspace regularly; the Chileans are the only ones for whom exposure to other media modalities has not shown to be significant.

In all three countries, living in cities with more than 100,000 inhabitants increases the chances of using digital technology. Another characteristic of web' users is that they are more participatory than the rest of the population. In terms of values, the internauts of the three countries were more critical compared to the general population. In Brazil, the Internet user relies less on Congress, on government and on the Church, and more on private companies. Schegel (2009) concludes that, in the recent democracies of South America, the Internet presents, at first, as a mechanism that helps to increase the voice of those who already had advantages in the public space.

ParticipAct Brazil

ParticipACT Brazil is a research project developed by the University of Santa Catarina (UDESC) in partnership with the Federal University of Santa Catarina (UFSC) and the University of Bologna (UNIBO) in Italy. The goal is to exploit information and communication technologies (ICTs) to structure large databases and thereby improve the management of smart cities. One example is the use of smartphones to collect data on urban problems. Another work front is the crossing of databases of a city, such as electricity consumption, garbage production, vehicular traffic, car accidents, urban violence, among others.

To achieve the goal, the project has a multidisciplinary group of researchers working together to explore the different areas of knowledge. Among engineers and computer scientists, the study is aimed at structuring the computational platform capable of receiving and processing data, organize and present them. Among managers, the concern is to promote the necessary interaction between public and private organizations in an intelligent city, design information flows, manage databases, address data protection, and the responsible use of such information. There are also researchers analysing citizen interaction in virtual environments, and the ability of these environments to awaken civic awareness, engagement and broaden participation in decisions on public issues.

Besides that, ParticipACT Brazil also study a kind of e-government for intelligent cities, capable of harnessing the power of collective intelligence, with the self-organization and participation of citizens, creating a class of services called participatory services. In 2018, after controlled environments tests, a beta version of mobile crowdsensing application was ready for the streets of a city. In addition, a website also aired with information about the project, the results of technological studies and georeferenced maps presenting the reports of users.

Florianópolis was chosen because it is the place where the researchers from two of the three universities involved in the research (UDESC and UFSC) and because its characteristics that could facilitate the tests, such as population concentration in the insular region and problems of mobility previously mapped out that mobilize society in social networks.

In addition, in the last three decades, the city has been struggling to implement a culture of innovation. According to the Catarinense Association of Technology [ACATE, 2015], there are 1,700 technology-based companies, three technology parks, six business incubators, 15 universities and 10 technology centres. Every 100 thousand inhabitants, 2,891 work with technology, which represents the largest concentration of employees in the sector in every

country. These characteristics could facilitate the dissemination of the ParticipACT Brazil application and social engagement in the crowdsensing process.

From August to December 2018, a publicity campaign with the press, associations, NGOs, public agencies and social networks invited the population of Florianópolis to download the APP and report urban problems. The purpose of this article is to analyse the population' engagement. The data were extracted from the application, which presents the users' interactions. These interactions allow us to evaluate the regions of greater engagement, the issues motivated social participation and infer some barriers to participation in virtual environments.

Seminal Expected Results

Mobile Crowdsensing and Engagement

ParticipACT Brazil proposes to explore the resources of mobile crowdsensing to solve, in a collaborative way, problems of collective interest. This requires a high level of civic awareness, engagement and social participation. The information collected from people are valuable resources for those responsible for thinking about the future of cities. The ability to exploit collective intelligence to achieve common goals, as the ideas of e-participation and e-inclusion suggest, is still very limited (Fogg, 2009). One of the objectives of ParticipACT Brazil is to integrate the virtual and real scenarios of an intelligent city, facilitating behaviours and actions that improve governance through citizen participation (Bellavista et al, 2014). That is, a multidirectional view on the motivations for virtual engagement (Norris, 2001).

Crowdsensing solutions enable large-scale data collection, from collaborative actions through mobile devices such as smartphones. This is the use of a participatory tool, which involves the population in collecting information that aims to improve people's quality of life.

The mobile crowdsensing consists of a central management of smartphone campaigns and applications.

For a mobile crowdsensing it is necessary:

(i) the management of a campaign;

(ii) persons;

(iii) the tasks to be performed at specific locations.

The goal of the campaign is to coordinate the tasks to be accomplished, some of which only involve authorization for the system to read data already available on the device. These are called "passive tasks". Other cases, however, may require some action from users, such as answering questions or photographing a location. These actions are called "active tasks".

The main characteristic of mobile crowdsensing is the possibility of exploiting the power of voluntary collaboration in data collection in order to generate knowledge about situations of interest in a city. Once registered in the system, the campaign begins when users are invited to participate in the collective effort. From there the citizen participates by sharing his time and the data of his cellular to carry out the requested tasks. All the information about the campaigns must be transparent to the citizen, since it is a collaborative process and coproduction (Verschuere, Brandsen & Pestoff, 2012).

ParticipACT Brazil and Engagement

In August 2018, the ParticipACT Brazil team made available to the population of Florianópolis the crowdsensing mobile application with a campaign on urban problems. The citizens were invited to report the most different problems in daily life related to mobility, accessibility, safety, environment, transportation, neighbourhood and social issues.

The invitation was made through social networks, spontaneous media in the local press, meetings with neighbourhood associations, city hall, non-governmental organizations, business associations and other organized civil society groups that accepted to receive the researchers to show the project. The communication strategy was address to groups that were already engaged

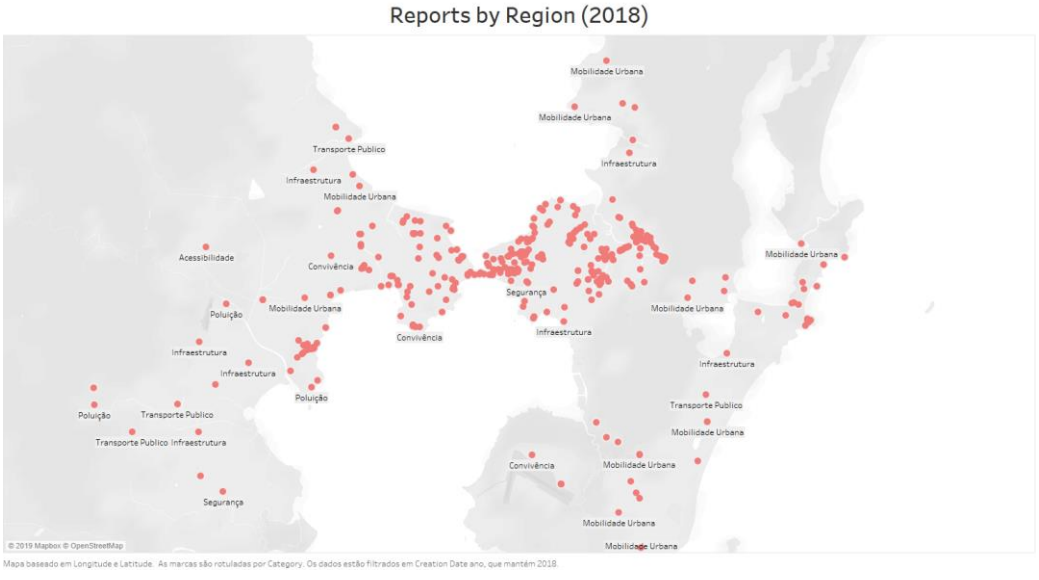

Figure 1. Reports by region

in offline world. After five months of this communication action, the project reached a total of 2,000 users who participated with 412 reports and 50 feedbacks to the system. The analyses of profiles, a concentration of users is observed in the central regions of the city (Figure 1). These regions are usually those with the highest daily circulation of people.

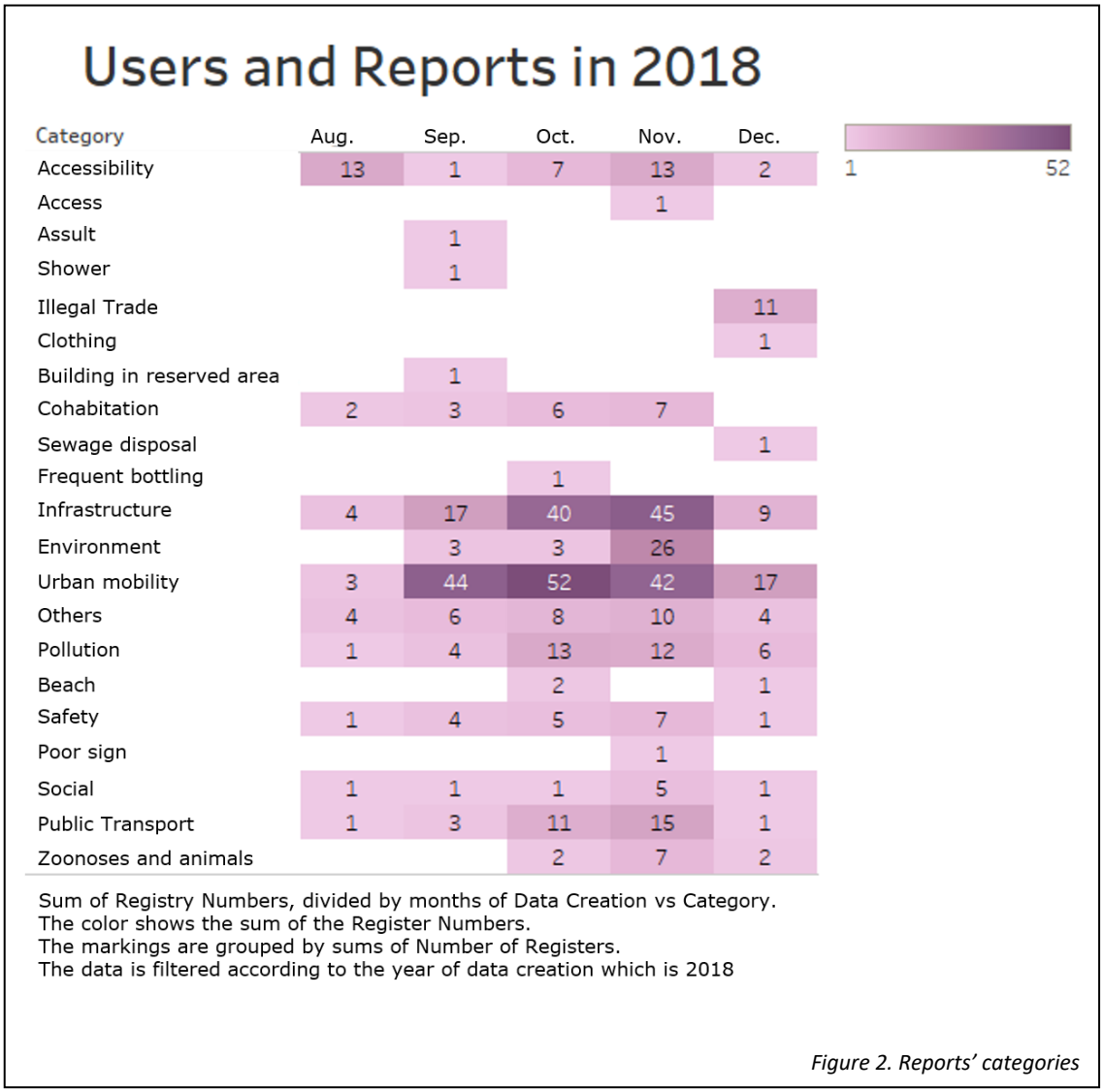

Figure 2. Reports' categories

Related to most frequently reported subjects, we can see the preponderance of urban mobility, one of the main urban problems in Florianópolis, which already engage society in offline spheres and seems to be reproduced on virtual environment (Figure 2). Most users reported 1 to 3 urban problems. Above this number, there are some assiduous users, which also reproduce the behaviour in offline spaces of participation (Figure 3). Another data shows that the peak of downloads occurred in November 2018. One possible explanation for this phenomenon is the adherence to the project of the Chamber of Shopkeepers of Florianópolis (CDL Florianópolis), which started to use the application for report illegal points of trade. Because of this, in November, there was also more exposure in the press and social networks.

The content analyses the feedback messages from the crowdsensing system and organized civil society that the researchers had access to during the dissemination of the project. The main criticism was the lack of a rapid return of the public power responsible for solving urban problems. The citizen got the feeling of being "talking to themselves". The problems were reported and disclosed, but without the commitment of those in charge with the solution. This negative feedback can be offset by the integration between the crowdsensing system and the Brazilian public ombudsman, a new development of the project.

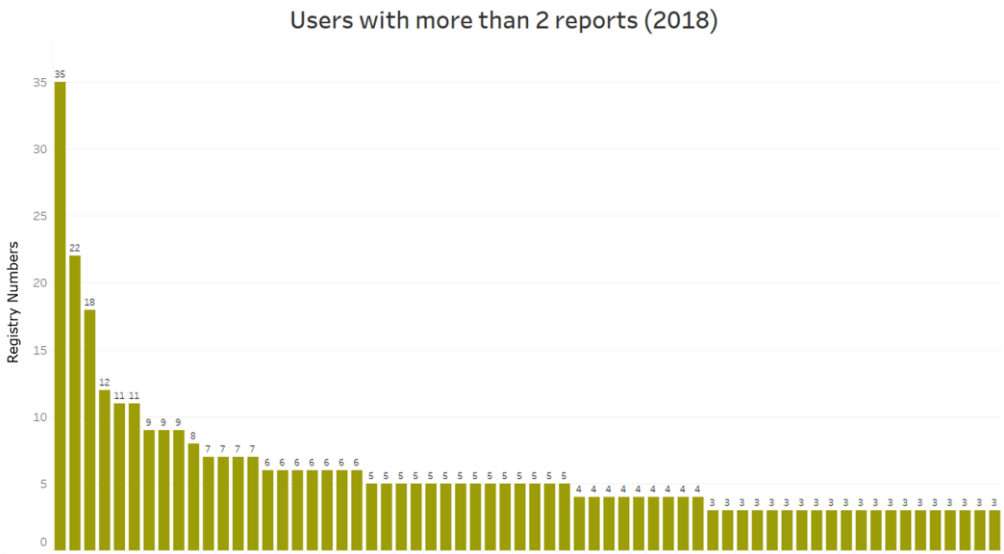

Figure 3. Users with more than 2 reports

Ongoing Research Directions

ParticipACT and Public Ombudsman

After a direct test with the population of the city, the Office of the Comptroller General of the Union (CGU), an organization responsible for controlling the services offered by Brazilian public agencies, a kind of citizen ombudsman, sought the coordinators of ParticipACT Brazil to propose an integration crowdsourcing systems and public ombudsmen.

CGU and ParticipACT technicians have been working since February 2019 to integrate the systems so that citizen reports are sent directly to the public agency responsible for solving the problem. Until May 2019, integration was still at an early stage and testing had not been completed. However, this almost natural route taken by the project demonstrates that Brazilian

society has limitations to social participation. Despite the barriers to civic and social commitment are still difficult to overcome, it is believed to be able to advance along this path by taking advantage of an increasingly necessary multidisciplinary approach.

ParticipACT Brazil and public services evaluation

The CGU also proposed to adapt the Brazil ParticipACT system so that it can be used in the evaluation of public services. One example, which went through tests in May 2019, is the evaluation of school meals. Brazilian public schools offer meals to students, but there is no effective control that the menu approved by nutritionists is being followed by all school units. Considering the continental dimensions of the country, the large number of public primary schools (181,900) and endemic corruption in all spheres of public service, a technological tool is necessary so that students themselves could evaluate the service.

This problem led the CGU to propose to ParticipACT researchers the use of mobile crowdsensing to monitor school meals. In this case, CGU and ParticipACT technicians were in the testing phase in May 2019.

Conclusions

This paper explored the opportunities related to Mobile Crowdsensing in a multidisciplinary prospective, considering it increasingly necessary to understand the complexity of the modern society.

Technologies are more and more connected with the human behaviours in a mutual exchange which affects both in often unpredictable ways. It is therefore necessary to try to understand as much as possible the peculiarities of digital technology and its influence on contemporary society. ParticipACT Brazil try to comply this task, highlighting the numerous problems linked to the social aspects described above. The encouraging results of the ParticipACT project can be considered of certain interest and are stimulating further research in the area of mobile crowdsensing.

More specifically, the opportunity offered by CGU in the last year represents an interesting challenge for the researchers that may enable new research paths and stimulate furthermore MCS developments in a more multidisciplinary prospective that take advantages from suggestions provided by the final user. On one hand, the researchers are designing new solutions to integrate ParticipACT into the Municipality system, in order to enable a positive loop that fill-

up the still existing gaps in the smart city management. On the other hand, the technicians are developing new services (such as the one related to the quality of meals in Brazilian schools) that focus on concrete problems and that can meet the needs of both public opinions and public administrators in order to enhances relations between each other.

References

ACATE Tech Report, 2015. Disponível em https://www.acate.com.br/node/101605. Acesso em: 20 jul. 2017.

Capponi A., Fiandrino C., Kantarci B., Foschini L., Kliazovich D., Bouvry P. (2019). A Survey on Mobile Crowdsensing Systems: Challenges, Solutions and Opportunities, in *IEEE Communications Surveys & Tutorials*.

Bellavista, P., Cardone, G., Corradi, A., Foschini, L., Ianniello, R. (2015). Crowdsensing in Smart Cities: Technical Challenges, open issues, and emerging solution guidelines. Dipartimento di Informatica - Scienza e Ingegneria (DISI), University of Bologna, Italy.

Bellavista, P. et al., 2018. ParticipAct for Smart and Connected Communities: Exploiting Social Networks with Profile Extension in Crowdsensing Systems. In: *Smart and Connected Communities: Technological Foundations, Challenges and Opportunities.* New York: ACM, pp. 1-6.

Best, S.J.; Krueger, B. (2005). Analyzing the representativeness of internet political participation. Political Behavior, v. 27, n. 2, p. 183-216.

Borba, J.; Ribeiro, E. (2010) Participação convencional e não convencional na América Latina. Revista Latino-Americana de Opinión Pública, v. 1, p. 53-76.

Boulianne, S. (2009) Does internet use affect engagement? A meta-analysis of research. Political Communication, 26:2, p. 193-211.

Cardone, G. et al., 2013. Fostering ParticipAction in smart cities: a geo-social. *IEEE Communication Magazine,* 51(6), p. 112–119.

Chatzopoulos, D., Gujar, S., Faltings, B. & Hui, P., 2018. Privacy Preserving and Cost Optimal Mobile Crowdsensing Using Smart Contracts on Blockchain. *2018 IEEE 15th International Conference on Mobile Ad Hoc and Sensor Systems (MASS)*.

Chessa, S., Corradi, A., Foschini, L. & dan Girolami, M., 2016. Empowering mobile crowdsensing through social and ad hoc networking. *IEEE Commun,* 54(7), pp. 108-114.

Fogg, B. J. (2009). A behavior model for persuasive design. (2009). Persuasive '09: Proceedings of the 4th International Conference on Persuasive Technology, pp. 1-7.

Hafner-Fink, M.; Oblak Črnič, T. (2014). Digital citizenship as multiple political participation? Predictors of digital political participation in Slovenia. Teorija in Praska, let. 51, p. 1284-1303.

Marjanović, M., Antonić, A. & Podnar Žarko, I., 2018. Edge Computing Architecture for Mobile Crowdsensing. *IEEE Access,* Volume 6.

Nie, J. et al., 2018. A Socially-Aware Incentive Mechanism for Mobile Crowdsensing Service Market. *2018 IEEE Global Communications Conference (GLOBECOM).*

Norris, P. (2001). Digital divide: civic engagement, information poverty and the internet worldwide. Cambridge: Cambridge University Press.

Norris, P. (2002). Democratic Phoenix: reinventing political activism. Cambridge: Cambridge University Press.

Norris, P.; CURTICE, J. (2006). If you build a political web site, will they come? The internet and political activism in Britain. International Journal of Electronic Government Research, 2(2), p. 1-21.

Ribeiro, E., Borba, J., Hansen, J. (2016). Participação on-line e off-line no Brasil: relações e condicionantes. Rev. Serv. Público Brasília 67 (4) 497-523.

Sanjaya, I. M. A., Supangkat, S. H. & Sembiring, J., 2018. Citizen Reporting Through Mobile Crowdsensing: A Smart City Case of Bekasi. *2018 International Conference on ICT for Smart Society (ICISS).*

Schlegel, R. (2009). Internauta brasileiro: perfil diferenciado, opiniões indiferenciadas. Revista de Sociologia e Política, Curitiba, v. 17, n. 34, p. 137-157.

Verschuere, Bram; brandsen, Taco; pestoff, Victor. Co-production: The State of the Art in Research and the Future Agenda. Voluntas: International Journal of Voluntary and Nonprofit Organizations, [s.l.], v. 23, n. 4, p.1083-1101, 18 jul. 2012.

Xiao, Y. et al., 2013. Lowering the Barriers to Large-Scale Mobile Crowdsensing. In: *Proceedings of the 14th Workshop on Mobile Computing Systems and Applications.* Jekyll Island, Georgia: ACM, pp. 9:1--9:6.

Xenos, M.; Moy, P. (2007). Direct and differential effects of the internet on political and civic engajament. Journal of Communication, 57 (International Communication Association), p. 704–718.