UrBis: A Mobile Crowdsourcing Platform for Sustainable Social and Urban Research in México

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Abstract Recently, the United Nations Human Settlements Program (UN-HABITAT) stated that cities in Mexico are steadily expanding, sometimes outstripping the rise in population by two-fold due to urban sprawl, and that 85% of the Mexican population will live in towns and cities by 2050. México also has booming young populations, who are not only the inheritors of significant social

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and urban problems, but also the most promising source of solutions. UrBis is a technological platform that was developed to help people in México, particularly youth, document, characterize and reflect about the social and urban problems they face. The platform supports an integrative approach that combines mobile crowdsourcing, social technologies and community practices to effectively document, characterize, reflect about socio-urban issues, and to develop possible solutions through the combined effort of citizens. The purpose of this paper is to share our action-research experience with UrBis in engaging youth populations in the field, outlining our findings after analyzing collected data in an effort to determine how our technological-based approach supports the study of urban environments in five cities located across the country.

Keywords Information technologies · Mobile crowdsourcing
Sustainable community practices · Action-research · Socio-urban studies

1 Introduction

In its most recent report on the state of the world cities, the United Nations predicts that by the year 2030, more people in every region of the world will live in urban more than in rural areas (UN-HABITAT 2012). The report states that cities in México are steadily expanding, sometimes outstripping the rise in population by two-fold due to urban sprawl, and that 85% of the Mexican population will live in towns and cities by 2050. The urbanization process in México is a phenomenon not only characterized by the growth of urban populations, but also by complex changes in aspects such as the demographic composition; the scale, density, and functionality of urban settlements; the lack of employment; different modes of governance, societal values, as well as the composition of ethnic, social and cultural groups (UN-HABITAT 2012). For these reasons, Mexican youth, which accounts for 26% of the total population (INEGI 2010), is not only the inheritor of significant socio-urban challenges but also the most promising source of sustainable solutions.

The rising question is how can we incentivize young people in Mexico to become more aware of their urban environment? How can we help them gain a deeper understanding and insights about the social and urban problems they encounter? How can we empower them create effective citizen-based solutions that foster the collective participation of society?

UrBis is a technological platform which was developed to help people, particularly youth, document, characterize and reflect about the social and urban problems they face. The platform supports an integrative approach (called SenseCityVity) that combines mobile crowdsourcing, social technologies and sustainable community practices to effectively document, characterize, reflect about socio-urban issues, and to develop potential solutions through the collective participation of citizens (Castells and Himanen 2014; Ruiz-Correa et al. 2014, 2017).

UrBis enables deployment of *mobile crowdsourcing* experiments in the form of *Urban Data Challenges* (UDCs) co-designed by our action-research team and community of young people, focused on:

- collecting and mapping georeferenced images, audio, video, text and surveys; as well as analyzing, appropriating, and
- creatively using the collected data for community reflection and development of potential solutions for sustainable development.

The purpose of this paper is to share our action-research experience with UrBis in engaging youth populations in the field, summarizing our findings after analyzing the data in an attempt to determine how our technological-based approach supports the study of urban environments in five important Mexican cities: Cortazar, León, Guanajuato, Mérida and Torreón.

2 An Integrative Approach

UrBis is a digital platform that integrates community practices, mobile crowdsourcing for data collection, and mixed methods for analysis (both quantitative and qualitative) to advance the understanding of how we can help citizens in Mexico better document, characterize, and reflect on urban concerns. At the same time, we aim to generate previously unavailable data resources and create suitable conditions for transforming the collected data into insights about social and urban issues, with the aim that citizens can develop community-oriented solutions to problems that matter to them. Beyond the creation of maps, our approach encourages the use of the collected data for educational endeavors with emphasis in youth groups. Our work helps demonstrate that integrating existing methods and best practices in ubiquitous computing and human computer interaction with the understanding of a specific social context can result in a participatory framework that exploits phone-based sensing to let everyday citizens survey and articulate urban challenges. Mobile technology enable participants share their experiences and reflections in a variety of ways, thus facilitating the interaction with government institutions that support their efforts. Our approach has six main characteristics, which enabled us conduct urban studies in five cities possessing distinctive urban features:

- It can be easily implemented in the field due the technological flexibility provided by UrBis platform.
- Facilitates the collection of multimedia data that complements traditional data sources such as social media streams.
- Fosters the participation and education of populations from different social segments.
- It is applicable in a wide variety of urban environments.

- It integrates sustainable community practices.
- Facilitates data dissemination and interaction leading to synergies between citizens and government institutions.

3 Mobile Crowdsourcing

Crowdsourcing refers to a sourcing model in which contributions from Internet users are gathered to accomplish a specific task. *Mobile crowdsourcing* involves activities conducted through mobile devices such as smart phones, which allows for real-time data gathering with greater reach and accessibility. This technique enables participatory sensing of urban spaces by combining the collective participation of citizens and sustainable community practices. In the context of our research experience such practices include social service activities, and volunteer work organized with the help of teachers, members of community groups, and NGOs, among others. Mobile crowdsourcing techniques facilitate sustainable socio-urban research for two reasons. First, as we show here, the same technological platform can be used to engage in different action-research projects. Reusing previously developed technology significantly lowers the implementation cost of a new project. Second, target populations are directly engaged in the development and implementation of the research experience. As a consequence, the outcome directly relates to solutions of problems that matter to them, increasing the likelihood of successful results. The integration volunteer's action and local community practices lead to a sustainable research process due to a steady interest of volunteers in finding effective solutions.

4 Urban Laboratories: Cortazar, Guanajuato, León, Mérida and Torreón

Guanajuato is a touristic city in central Mexico, and the capital of a state of the same name. The city occupies a valley, forming a complex network of narrow roads, pedestrian alleys, and stairways running uphill. Guanajuato is a historical city and a UNESCO world heritage site, with a vibrant tourism industry that is centered on the city's historical downtown area and several large art festivals. The city of *León* is a business and industrial hub in the state of Guanajuato that drives a large part of the economical activity of the state. León has a strong leather industry, offering products both to the national and international markets. León also receives a large number of visitors. *Mérida*, the capital of Yucatán state, is the largest historical city in the Yucatán peninsula. Mérida is located in the southeast of the country, 22 miles away from the Gulf of México. The city, funded in 1542 by the Spanish crown, is today one of the most vibrant and traditional cities in south México.

Table 1 UrBis platform was used to conduct 6 UDCs in 5 cities across México

City (population)	UDC	Social actors involved
Cortazar (34,500)	SCV-Cortazar	Instituto de la Juventud Guanajuatense, and Universidad Politécnica de Guanajuato (UPG)
Guanajuato (170,000)	SCV-Guanajuato	Centro de Estudios Científicos y Tecnológicos (CECYTE) Guanajuato, and local volunteers
León (1,500,000)	SCV-León	ITSI León, Universidad Iberoamericana León, and local volunteers
León (1,500,000)	SCV-Lobo	Instituto de la Juventud Guanajuatense, Casa del Adolescente de León, and Instituto Municipal de la Juventud de León
Mérida (777,616)	SCV-Mérida	Universidad Autónoma de Yucatán, Campus de Arquitectura, Hábitat, Arte y Diseño (CAHAD), and Unidad Académica Bachillerato con Interacción Comunitaria (UABIC)
Torreón (634,629)	SCV-Torreón	Escuela de Sistemas Unidad Torreón de la UA de Coahuila

Each challenge was lead by our action-research team in collaboration with participant local institutions and volunteers

Torreón is located near the southwest border of the northern state of Coahuila, within the so-called Laguna region. Torreón is one of Mexico's most important economic and industrial centers neighboring Matamoros, Gómez Palacio, and Lerdo municipalities. Finally, *Cortazar* is a small city located in Guanajuato state. Cortazar is an industrial hub located within the main industrial corridor of the state. It also has agro-industrial infrastructure, which employs 15% of the economically active population of the region.

UrBis platform enabled our action-research team conduct UDCs in these cities (Table 1). Each challenge was lead by our team in collaboration with local actors that supported our fieldwork. Two UDCs were organized in León city with the aid of independent groups of volunteers. Actors participating in the challenges include students, teachers and school authorities of universities and technical highs schools, officials from government institutions, and local volunteers. The goals of each UDC varied according to the needs and interests of the local communities (Table 2).

5 UrBis Architecture

The Urbis platform enables mobile crowdsourcing tasks through two main software modules. The first module consists of an Android mobile application that allows UDC users to capture georeferenced multimedia content (pictures, videos, audios, text and surveys). Users' collected data are automatically collated, synchronized and uploaded into the platform (Fig. 1). The other module consists of a back-end

Table 2 The goals of each UDC vary according to the needs of the local communities

UDC (year; duration in months)	Goals summary (no. volunteers; years of age)
SCV-Cortazar (2016; 3)	Use participatory sensing to document and characterize the urban environment of Cortazar City; (20; 18–22)
SCV-Guanajuato (2015; 14)	Use participatory sensing to document and characterize the urban environment of Guanajuato City. Make use of the collected data for artistic creation. Develop recommendations that could be useful for develop public policies to improve the city's urban environment; (200; 16–65)
SCV-León (2015; 6)	Use participatory sensing to examine how youth perceive their urban environment. Engage youth in a research experience as a means to enrich their studies and professional practice. Incorporate data and information collected in the field within classroom activities; (50; 18–22)
SCV-Lobo (2016; 4)	Support institutional efforts to diagnose the state young people in situation of social exclusion and risk of social violence in León city; (20; 18–40)
SCV-Mérida (2015; 3)	Develop a participatory sensing experiment lead by youth to document the positive and negative aspects of the urban environment in Mérida city (80; 14–25)
SCV-Torreón (2016; 2)	Identify and document problems in pavement and sewers in of Torreón city to provide timely information on the state of the city's transit routes (40; 18–22)

and front-end servers. The back-end server provides a set of PHP web services that use JSON technologies for data sharing among software modules. The front-end is a user-friendly UrBis website (HTML, CSS and JavaScript languages) that facilitates registration and administration of UDCs and users.

A designated user administrates each UDC. The administrator has privileges to access the visualization tools and gives permissions for other registered users to participate in the challenge as either data collectors or observers (Fig. 2). UrBis data integrity is kept through a secure non-relational database that allows great flexibility for storing and managing UDCs data. Our data collection process uses best practices to satisfy the requirements of anonymized data management, including those related to personal data safety (Laurilla et al. 2013).

6 UrBis Deployment and Data Collection

Each UDC was conducted trough four main activities that enabled the integration of volunteers work supported by mobile and social technologies: recruit a population of volunteers, co-design a mobile crowdsourcing experiment (that is, an UDC), implement the UDC, encourage participating volunteers to reflect about the positive

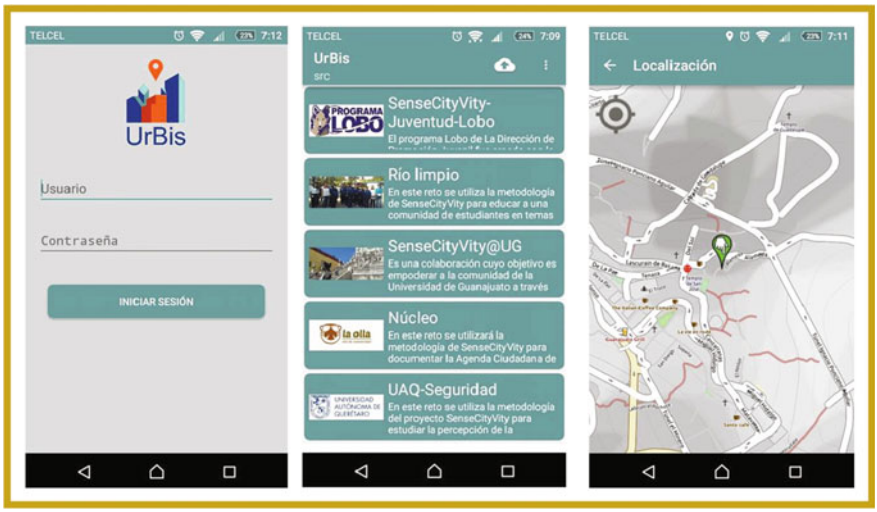

Fig. 1 UrBis mobile application supports data collection for multiple UDCs. The application allows users capture georeferenced multimedia content (pictures, videos, audios, text and surveys). Data collected by the user are automatically collated, synchronized, and uploaded into a back-end server. The figure shows screen shots of the application: (left) UrBis access screen, (center) list of available UDCs of a user, and (right) geographic location of the user during data collection

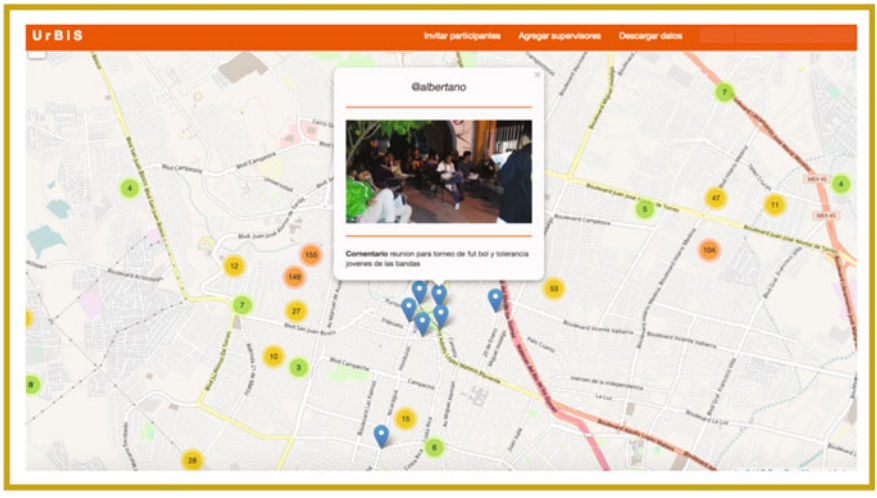

Fig. 2 UrBis front-end is a user-friendly website that allows users to administrate UDCs and visualize georeferenced data collected during fieldwork. The figure shows a León city area of León where data from one of the UDCs were collected. Colored circles indicate evidence (i.e. data) clusters. A friendly graphical interface allows users inspect the evidence within clusters (pictures, videos, images, text, and surveys)

and negative aspects of the data collected, and develop potential solutions based on the information distilled from it.

Recruiting volunteers. Action-research teams in each of the five cities recruited local volunteers from high schools, universities and government institutions (Table 1). The number of volunteers and age of participating in each UDC varied according to the specific goals of the challenge (Table 2). Populations of young people participated in all our UDCs. In Guanajuato, a population of 16 seniors also participated in the UDC. SCV-Lobo was lead by a group of young adults trained to engage young people in situations of social exclusion and risk of social violence. The recruitment process for took 3–4 weeks of intensive work by our research action-team (Table 3). The process included workshops emphasizing the importance of the collective participation of citizens to address socio-urban issues and the role that mobile technology can play to empower people to make improvements. Volunteers were organized into groups consisting of 5–10 members each. To incentivize student participation, registered volunteers were allowed to accumulate the time spent in UDC activities toward their social service requirement. A total of 480 registered volunteers participated in the six UDCs.

Co-designing the experiment. For each UDC, our action-research team and the participating volunteers designed the mobile crowdsourcing experiment.

Table 3 Recruitment workshops were conducted for each UDC

UDC	Recruitment period in weeks	Recruitment workshops	Participants	Codesign workshops	Social media
SCV-Cortazar	2	1	Students, school authorities, government officials	1	Facebook
SCV-Guanajuato	4	4	Students, teachers, school authorities, parents, and seniors	4	Facebook and Twitter
SCV-León	4	4	Students, teachers, and school authorities	4	Facebook and WhatsApp
SCV-Lobo	2	1	Students, government officials	2	No
SCV-Mérida	4	2	Students and teachers	2	No
SCV-Torreón	3	2	Students and teachers	2	WhatsApp

Workshops were lead by our action-research team

The co-design was conducted during workshops that led to discussions about mobile and social media technologies for the common good, ethics, data privacy, personal safety, urbanism, and basic techniques in photography. During the last workshop, participating volunteer groups developed a chronogram of the activities that would be conducted during the UDC. Groups were instructed to center their attention on urban challenges affecting the city landscape focusing on both positive and negative aspects. Therefore, each group defined one, two or three urban problems they wanted to document and the specific approach to conduct their investigation. Some of the urban concerns highlighted during the co-design workshops ranged from garbage in the streets and alleys to crime and vandalism, worn public infrastructure, graffiti, and the prevalence of alcoholism and drugs. In the specific case of SCV-Lobo, participants conducted a survey designed to give a basic characterization of youth facing social exclusion issues in impoverished neighborhoods of León city. In SCV-Lobo, the UrBis platform was used to apply the survey to groups of marginalized youth that agreed to contribute voluntarily. Besides the surveys, pictures, videos and audio interviews were collected in the field.

Implementing the UDC. Urban Data Challenges had duration between 2 and 12 months (Table 2). Challenges mainly consisted of safe data collection activities. Fore example, in Guanajuato city, fieldwork was mainly conducted on weekends. On these weekend gatherings, members of our action-research team led a review session to reinforce the key ideas discussed during the workshops and to check each group's work plans for data collection. This check was necessary to ensure that student groups didn't visit unsafe parts of the city. After the review session was finished, each group moved independently to document the various parts of the city using mobile phones. Smartphones were given to each team; however, volunteers also used their own phones for data collection after they downloaded the UrBis application. During the UDC, students groups explored and documented various routes within the city, which can be seen on an animated map at http://bit.ly/1ZS6yij. Another example is SCV-Torreón, in which volunteers worked in areas of the city that were safe to document. The city was previously subdivided into twenty square regions that were explored during weekdays for documenting potholes and clogged sewers in streets and sidewalks. Many of the documented potholes are known to previously caused street accidents and damaged cars. In Mérida city the data challenge took place in eight sectors of the city that surround the high school campus that hosted the UDC (Fig. 3). Only volunteers that have specialized training to interact with marginalized youth conducted SCV-Lobo. The interaction took place following a protocol approved by government experts with more than 25 years of experience helping young people in situations of social exclusion and risk of social violence. The routes explored by volunteers can be seen an animated map at http://bit.ly/2lEJ2tK. Four of the UDCs integrated the use of social media to maintain communication with participant groups while collecting additional images through a dedicated channel (Fig. 4).

Fig. 3 This figure shows a collage of pictures taken during the SCV-Mérida UDC

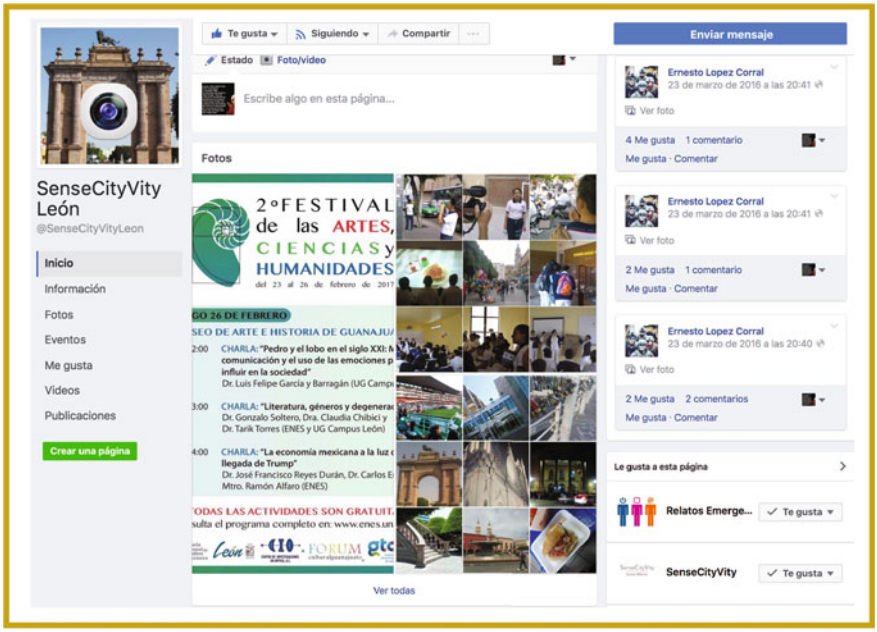

Fig. 4 UDCs integrated the use of social media to maintain communication with participant groups. SCV-León Facebook page is shown in the figure

7 Data Analysis

Data collected during each UDC was analyzed with quantitative and qualitative methods.

A statistical characterization of the collected data was conducted through the calculation of descriptive statistics, the computation of several types of choropleth maps (v.gr. heat maps, cluster maps, and torque maps) (Slocum et al. 2014) and hypothesis testing of georeferenced data (Haining 2003). Recorded interviews were analyzed by means of the qualitative methods described in (Creswell 2014).

Our action-research team shared the information distilled from collected data with participating volunteers as a means to incentivize reflection and discussions about positive aspects of the urban landscapes explored and possible solution to the socio-urban problems detected. UDCs leaders elaborated a report describing their work and potential solutions to these problems.

Although the general methodology used by all UDCs is the same, their goals are different and therefore, the nature of the information distilled from data for each UDC is quite different. For example, SCV-León UDC emphasized the importance of documenting urban perception and awareness of participant volunteers thorough qualitative techniques. On the other hand, UDCs in Torreón and Mérida focused in documenting the urban environment through quantitative measures. SCV-León, SCV-Cortazar and SCV-Guanajuato used both quantitative and qualitative methods to distill information from collected data.

8 Constraints and Limitations

Our research on socio-urban environments was constrained to specific areas of mid-sized and small cities in México that that were safe for data collection activities to take place during the UDCs. Cities in México suffer from a wave of violence that limits the use of our approach to study urban environments affected by violence/criminal activities. Except for SCV-Guanajuato, the number of participating volunteers in each UDC was limited to less than 100 people. This limitation was adopted as a means to facilitate the organization of volunteers within the institutions that supported the implementation of the UDCs.

9 Results

The collected data of each UDC is rich in content. It is enabling a number of qualitative and quantitative studies, also briefly discussed here.

9.1 Collected Data

Pictures were used as the principal means for documenting issues. A total of 12,426 geolocalized images were collected during the six data challenges (Table 4). The least number of pictures were collected in Mérida (347), and the largest number in Guanajuato (7000). A total of 215 videos of urban scenes were collected in SCV-Cortazar, SCV-Guanajuato, and SCV-Torreón (Table 4). Fifty-eight geolocalized audio-recorded interviews were collected in the filed (SCV-Cortazar, SCV-Guanajuato, and SCV-Lobo). Geolocalized surveys were conducted in SCV-Cortazar (129) and SCV-Lobo (44).

9.2 Mapping Evidence

From a quantitative viewpoint, one of the first tasks was to create heat maps for each UDC to identify areas where participants collected data. We created these maps by applying density estimation techniques to GPS locations embedded in the geolocalized data. Four heat maps are shown in Fig. 5 corresponding SCV-Guanajuato, SCV-León, SCV-Cortazar, and SCV-Lobo UDCs. Colored regions in red indicate higher data density compared to those colored in blue. The heat map corresponding to SCV-Guanajuato (top-left) shows regions in red with higher incidence of urban issues. Heat maps and sample pictures from the other UDCs are not shown due to lack of space. UDCs data sets are heterogeneous and rich in content, which depicts features of each city related to the context of the goals of each UDC. For instance, SCV-Lobo UDC contains data related to the urban context of impoverished areas in León city, which includes images/videos depicting graffiti, murals (religious images) and urban sites. These data contrast with those of SCV-Torreón UDC, which is very homogeneous, and mainly portray deteriorated street infrastructure.

Table 4 Data collected during the UDCs conducted in 5 cities

UDC	Pictures	Videos	Audios	Surveys
SCV Cortazar	894	86	9	129
SCV-Guanajuato	7000	85	20	–
SCV-León	1357	–	–	–
SCV-Lobo	1816	40	29	44
SCV-Mérida	347	–	–	–
SCV-Torreón	1012	4	–	–

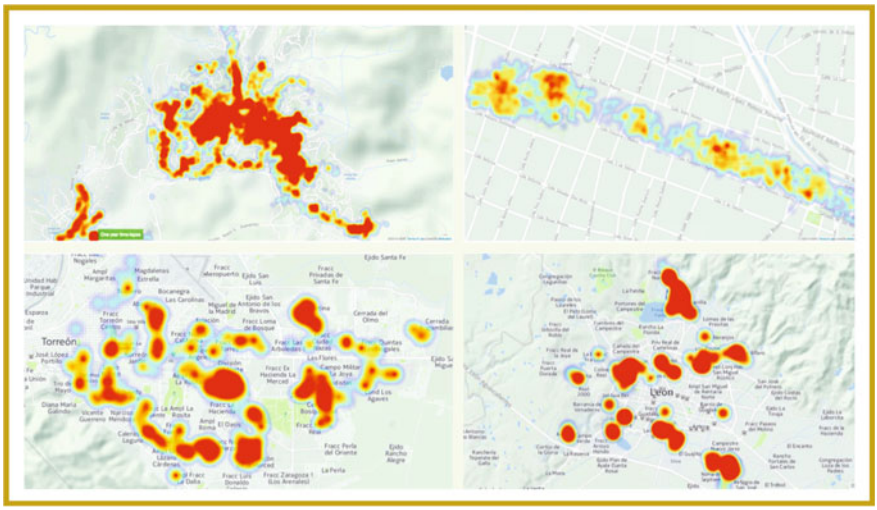

Fig. 5 Evidence heat maps computed for: (top-left) SCV-Guanajuato, (top-right) SCV-León, (bottom-left) SCV-Torreón, and (bottom-right) SCV-Lobo UDCs. Colored regions in red indicate higher data density compared to those colored in blue. The heat map corresponding to SCV-Guanajuato shows data corresponding to urban issues such as garbage, deteriorated infrastructure, inaccessibility issues, etc. Therefore, regions colored in red indicate of higher incidence of urban problems. Most of the SCV-León data were collected in the main street leading to the historic center

9.3 Videos of Urban Scenes

UDC participants in Guanajuato, León and Cortazar, recorded 211 videos to capture urban issues (such as a large wall with painted graffiti on a bridge or tunnel) or to show relevant events (such as a bumpy ride in a city bus or a pedestrian crossing a dangerous street). Collected videos last between close 6–10 s on average. About one third of these videos include comments from the person recording it, which makes these videos valuable to understand how volunteers feel about their city. This kind of fieldwork, which requires direct interaction with people on the street, offered a unique opportunity for participants to experience of the dynamics of the urban landscape. It also let them reconnect to the tangible reality of their city through the lens of their mobile device.

9.4 Emerging Themes

Themes captured by participants were manually coded from audio interviews, videos of urban scenes and surveys captured in SCV-Guanajuato, SCV-Lobo, and SCV-Cortazar UDCs.

SCV-Guanajuato UDC. Three categories were used to code emerging themes: (a) city image—showing littered garbage, graffiti, street dogs, and so on; (b) infrastructure—showing infrastructural problems, ranging from insufficient street lights and garbage containers to inadequate street access; and (c) quality of life—showing everything from vandalism, alcoholism, and drugs to insufficient public transportation.

In Fig. 6, we plot the number of participants who described a specific problem according to these three categories. This plot suggests which problems are perceived as more prevalent. Interviewed citizens agree that garbage, crime, and insecurity are the most pressing urban problems. Other problems that were also mentioned include: overpopulation, pots in streets, the lack of adequate sidewalks, the large number of people that work in the city but lives outside thus creating serious traffic problems. Perceptions also change according to the age. The senior population strongly agreed that many of the city's problems are caused by the lack of civic education and the lack of job for youth. Families are having a difficult time to create the appropriate environment to raise children in a suitable environment where human values, culture, and civism are the most important topics to teach to the new generations. The lack of work for young people is also a serious problem in the city. This problem has lead youth to engage into criminal activities and addictions. One of the interviewed participants mentioned that "[…] the lack of education is the source of crime, if parents do not teach their children to be respectful, to be honest, how do we expect not to have problems with violence when these children grow up?"

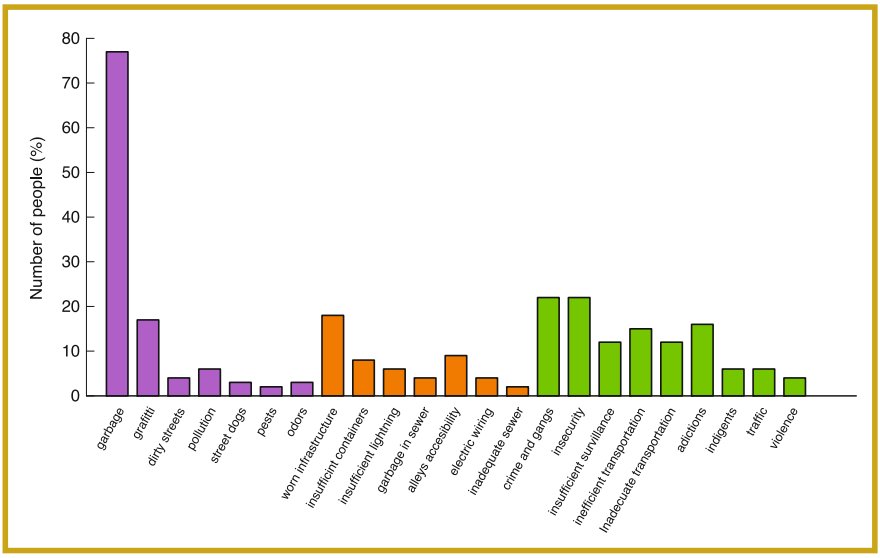

Fig. 6 Urban problems detected in Guanajuato City, which are further divided in three categories: the city image (purple), infrastructure issues (orange), and quality of city life (green)

These reflections agree with the fact that Guanajuato state has one of the largest population of youth that do not work or study: 540,000 youngsters (15–17) according to the data reported by the Instituto Nacional de Geografía y Estadística (INEGI 2010). On the other hand, youth are more concerned about problems affecting their immediate interaction with their urban environment (garbage, insufficient and inadequate transportation, insecurity, etc.) The views expressed by interviewed youth and seniors provide key insights on the origin of the observed urban problems, as well as the key issues that should be addressed. Education, strengthening of the family structure and creative ways of creating jobs for youth are some of the topics that should be considered to improve the socio-urban environments.

SCV-Lobo UDC. Three main themes emerged from the interviews: (a) the quality of life in the city, (b) worn on non-existing urban infrastructure, (c) social exclusion (lack of jobs), and (d) safety issues. People are very concerned about the lack of jobs for youth and the lack of care from their parents. These are two of the main causes for young people enter a gang or create new one. In general, a gang controls an urban space such a street or a block, which becomes a safe space for their members. Oftentimes, territory control is one of the main causes of violence among gangs. Social exclusion issues such as the lack of urban services and infrastructure exacerbate the conditions leading to a large number of gangs in León City. Although the exact number of street gangs in the city is not known, government officials from the Instituto Municipal de la Juventud León estimate that this number could reach over fifteen hundred with an average number of 20 members per band (personal communication by Martha Hernández). The pilot survey conducted during the UDC was aimed at characterizing street gangs in critical neighborhoods of León City such as Las Joyas, San Juan Bosco, and 10 de Mayo (Fig. 5). Table 5 summarizes the results of the survey applied to 44 gangs. In general, the surveyed gangs are composed mostly of males with more than double the proportion of women. The bands have an average of 25 members with a maximum average age of 20 years and a minimum average of 15. Children under 16 created some recently formed gangs.

Table 5 Results of a survey applied to 44 León city street gangs

	Mean	Median	Standard deviation	Min	Max
Number of males per band	21.18	20	9.67	10	50
Average number	8.05	7	6.48	0	30
Number of females per band	30.63	25	18.24	11	120
Number of band members	20.37	8	50.89	0.25	30
Age of the band	16.65	15	8.48	1	38
Average age of the youngest band members	20.27	20	10.66	2	40
Average age of the oldest band members	21.18	20	9.67	10	50

SCV-Cortazar. This challenge focused on documenting the perception a group of young people with regard to educational opportunities within the Cortazar City. The challenge considered the application of a brief survey and documentation of the urban environment where the surveys were applied (http://bit.ly/2m8xbF8). Young people 15–18 years of age participated in the survey, which consists of three key questions: (a) What is your main goal in life? (b) What are the main obstacles that force young people give up their studies? (c) What do young people need to go back to school? With regard to the first question 61.1% of the interviewed subjects aim at finishing university studies and become professionals, 19.8% are more interested in finding a good job, and the remaining 19.1% are focused on subjects like sports, music, and marriage. With regard to the second question, 50.3% believe that the main reason why students give up their studies is the lack of economic resources, 23.7% believe that young people lose the interest in continuing their studies due to a variety or reasons (such as social exclusion), and the remaining 30% believes that the main reason is related to family issues, the lack of abilities, antisocial behaviors, or premature pregnancy. With regard to the third question, most interviewed subject agree that there is urgent need to achieve an economic turn that results from actions conducted at institutional level, which leads to more resources, support and incentives for youth to continue their academic endeavors.

10 Urban Data Challenge Outputs

Beyond the collection and analysis of a novel and rich set of socio-urban data, UDCs resulted in an educational experience for participating volunteers and members of our action-research team. These experiences lead to a reflection and the articulation of potential solutions to the social and urban issues observed. With the aid of local actors, our action-research team wrote a formal report describing the details of each UDC. For SCV-Guanajuato, SCV-Cortazar, and SCV-Lobo UDCs, the reports were presented to local authorities and government officials as a means to promote synergies between citizen and government to find practical solutions to issues that matter to citizen through development of suitable public policies.

One of the findings of our work is that that there are social and urban problems that can only be addressed by government-lead solutions. However, we also found that there are many social and urban issues that can be directly addressed by citizens themselves. One example is the issue of garbage in Guanajuato City, which can be effectively addressed if citizens make a better use of the city's garbage facilities. The collective action of citizens can catalyze the government actions to solve pressing issues.

For SCV-Mérida, SCV-León and SCV-Torreón UDCs, the reports were presented to local school authorities to get further support for expanding the studies to larger areas of the city. For instance, SCV-Merida report is an 83-page document that employs urban ecology techniques to characterize eight sectors of a large Mérida City neighborhood. The document includes a diagnostic study based on

social, environmental, and infrastructural variables measured through various techniques, including mobile crowdsourcing. This document serves as a guide to conduct urban studies with the collective participation of citizens over larger areas of Mérida city. It can also be used as a model to conduct studies in other Mexican cities.

Finally we emphasize that the use of social media played a fundamental role in the creation of a communication channel with communities that continuously follow the information generated during the UDCs. Two notable examples are the SCV-León and SCV-Guanajuato Facebook pages, which are followed by a large audience since their creation in early 2015 (http://bit.ly/2lKqgBl and http://bit.ly/2lECpr3).

11 Conclusion

In this paper we have described an action-research experience in engaging youth populations in the field with the help of a mobile crowdsourcing methodology aimed at supporting socio-urban studies in the Mexican cities of Cortazar, León, Guanajuato, Mérida and Torreón. Our methodology combines mobile computing tools, social technologies and community practices to effectively document, characterize, reflect about socio-urban issues, and to develop possible solutions through the combined effort of citizens. Our mobile crowdsourcing platform (UrBis) enables deployment of field experiments in the form of Urban Data Challenges co-designed by our action-research team and community of young people. Our experiments focused on: (a) collecting and mapping georeferenced images, audio, video, text and surveys; and (b) creatively using the collected data for community reflection and development of potential solutions for sustainable development.

The results of the UDCs experiences described here suggest that the use UrBis platform can empower citizens and foster synergies with government organizations to document, characterize, reflect and propose solutions to socio urban issues. We have shown that UrBis facilitates the collection of rich multimedia data, fosters the participation and education of populations from different social segments, is applicable in a wide variety of urban environments, integrates sustainable community practices (such as the social service school requirements), and facilitates dissemination of data and information for a more effective interaction between citizens and government institutions. Preliminary results of ongoing UDCs conducted in Querétaro, San Luis Potosí, Guanajuato, and two cities in Colombia (data not shown due to lack of space) provide further support to our claims. The results of these new UDCs will be reported in a future paper.

Collection of multimedia content in Mexican cities had proven necessary in our action-research work. Platforms such as Foursquare, Google Street Map and Google Street View provide images of cities in México. However, there are many urban sites that are digitally invisible in these platforms. In a preliminary study, we demonstrated that in some areas of Guanajuato, as much as half of the data from

GSV have limitations (Ruiz-Correa et al. 2014). For this reason, the tools provided by UrBis facilitate mobile crowdsourcing studies where documentation of the urban sites and the perception of citizens about their socio-urban environment are of prime importance.

There are various related works, including civic reporting systems, youth and community engagement programs, open mapping initiatives, and social media. Due to lack of space, these topics are not discussed here. The interested reader can consult the following references (Santani et al. 2015; Ruiz-Correa et al. 2017).

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