Crowdsourcing Public Engagement for Urban Planning

Subjects: Regional & Urban Planning

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Crowdsourcing could potentially have great benefits for the development of sustainable cities in the Global South (GS), where a growing population and rapid urbanization represent serious challenges for the years to come.

crowdsourcing Global South urban planning developing countries

1. Introduction

Although the concept of crowdsourcing is fairly recent [1], the idea of engaging the public and non-experts in problem-solving and data collection has a long history in both research and practice. In 1936, the Japanese company Toyota (then Toyoda) organized a public contest for the design of its new logo [2]. In total, 27,000 designs were submitted, and the best logo was selected and used between 1936 and 1989. In the 1960s, public advocacy theory [3] emphasized the importance of public participation in urban planning. Other concepts, such as citizen science, and Public Participation Geographic Information Systems (PPGIS), follow the same principle of engaging the public to participate in the design and implementation of solutions to various problems regardless of their level of expertise. With the upsurge of the Internet, researchers and practitioners had to rethink the ways in which public participation is carried out and re-assess the societal transformation that comes with it. This led to the emergence of crowdsourcing, “a web-based business model requiring voluntary open collaboration to develop innovative solutions” [1]. By tapping into a large and diverse pool of stakeholders through the Internet and Web 2.0 technologies, crowdsourcing, as a public participation method, has alleviated the spatial and temporal constraints that are associated with the aforementioned methods.

The term Global South (GS) has several definitions which have economic, geopolitical, and cultural implications. Economically speaking, the GS groups developing countries characterized by, among other indicators, medium and low human development index (HDI less than 0.8). Geographically speaking, most of the GS is in the southern hemisphere and regroups African, Southern and Central American, and Asian countries (with the exception of Japan, South Korea, and Singapore). Due to their limited resources, these countries struggle to develop plans that could effectively address the challenges faced by contemporary cities. For example, in the Asia-Pacific region, over 50% of the Sustainable Development Goals (SDGs) cannot be measured due to a lack of data [4]. Fraisl et al. [5][6] have demonstrated that crowdsourcing could help monitor SDG indicators. Thus, crowdsourcing could be very useful to these countries as it allows gathering useful data, which in turn could support better-informed policies. From a historical point of view, most of these countries are former European colonies. As such, the traditional urban planning method consisted mainly of copying strategies implemented in the former colonial power [7][8].

However, these strategies are rarely successful as they fail to take into account the unique challenges faced by developing countries [9]. With its participatory approach, crowdsourcing could provide a platform that taps into the citizens' local knowledge to identify the main challenges faced by cities in the GS. This, in turn, could help planners better define their priorities and implement policies that meet the needs of the local communities. Furthermore, this democratized planning process through public participation can lead to more transparency and greater citizens' acceptance of public decisions [10].

In the Global North, crowdsourcing has helped democratize the planning process, empower citizens, provide low-cost data for real-time planning, and helped mitigate the limitations of traditional data collection methods such as census data [11][12][13][14][15]. In America, Thiagarajan et al. [12] used low-cost, grassroots GPS tracking solutions to improve riders' transit experience (e.g., reduction of waiting time), while Griffin and Jiao [15] demonstrated that collecting data through crowdsourcing increased the inclusiveness of the participatory planning process from the perspective of geography and equity. In Australia, K. Hu et al. [14] developed a low-cost participatory sensing system (called HazeWatch) for urban air pollution monitoring which yields more accurate measurements than the existing government system. The HazeWatch system provides a better understanding of the health impact of air pollution in metropolitan areas. In Italy, MiraMap [13], a we-government platform, helps facilitate the collaboration between the public and the administration while promoting social inclusion, transparency, and accountability in smart city management. These examples in the Global North show the potential value crowdsourcing could have for the GS, which is characterized by limited resources, low or inexistent citizen participation, and a lack of transparency, accountability, and data-driven planning methods.

However, despite these possible advantages, the potential of crowdsourcing remains to be exploited in the GS. This is even more true in Africa, where most urban studies rely on qualitative analysis or traditional data collection methods (survey questionnaires) instead of quantitative methods that require abundant and reliable data [16]. This affects the reliability of the findings and limits the effectiveness of the policies that could be implemented from the existing literature. Furthermore, the existing reviews on crowdsourcing in urban studies mainly provide a global overview of the literature [17][18][19][20][21][22]. These studies provide a clear understanding of the methods and challenges associated with the use of crowdsourcing. However, the GS faces specific cultural, technological, political, and administrative challenges which could greatly impact the successful use of crowdsourcing in this part of the world. To fill this gap, researchers present a review of the crowdsourcing research efforts conducted in the GS. The methods described focus on public engagement to support urban planning. Therefore, crowdsourcing in this context mainly consists of data collected and shared by the public through mobile devices (GPS tracking, crash reporting, environment monitoring, etc.) and/or local knowledge shared through collaborative websites (crime mapping, flood mapping, idea generation for smart city management, etc.). Furthermore, drawing from the descriptive statistics of the reviewed papers as well as the characteristics of the GS, researchers also discusse the challenges that could hinder the implementation of crowdsourcing.

2. Crowdsourcing: Definitions

Since Howe [1], several studies have provided different definitions of crowdsourcing. These definitions are important as they provide a basis for what should be considered crowdsourcing and what should not. For example, some studies perceive YouTube and Wikipedia as crowdsourcing [23] while others do not [24].

In urban planning, concepts such as problem-solving, idea generation, and collaborative mapping are widely accepted as crowdsourcing [23][25][26][27], while data collection methods such as social media scraping and crowdsensing are subject for debate [25][28] Brabham [25] defines crowdsourcing as a top-down approach to solving planning problems. This definition includes approaches such as idea generation for smart city solutions [23][29] but excludes data collection methods such as crowdsensing, Public Participation Geographic Information Systems (PPGIS), social media, etc. Nakatsu et al. [28] argue for a broader definition that includes “geo-located data collection” (e.g., GPS tracking, a form of crowdsensing) but excludes social media. Their main argument for excluding social media was the absence of explicit outsourcing of a task *to* the crowd. Furthermore, although social media have been widely adopted as crowdsourced data, the method usually consists of extracting people’s posts (social media scraping) through Application Programming Interfaces (APIs) without their consent. This could raise some ethical concerns as the people whose posts are extracted may not be willing to participate in data collection. Besides, Howe, who introduced the concept of crowdsourcing, also defined it as a voluntary process. Finally, Estellés-Arolas and González-Ladrón-De-Guevara [24] have provided a definition of crowdsourcing based on a thorough review of the existing literature. They found voluntary participation and a clearly defined task among the main criteria for crowdsourcing. Based on the aforementioned studies, the adoption of methods that do not necessarily require voluntary participation (such as social media scraping and crowdsensing) may be problematic. However, it would be too simplistic to discard all studies using social media or crowdsensing without exploring cases where the participation is voluntary and the task clearly defined. The next subsections address this issue in detail.

2.1. Social Media Data

Although most studies use social media scraping, there are specific cases in which the methods described meet the criteria researchers described above. These cases are:

- Voluntary participation in dedicated social media groups or pages. Dedicated social media pages can be open platforms for citizen engagement. In this case, the task could consist of submitting complaints (e.g., HarassMapEgypt, a Facebook page [30]), participating in e-governance or sharing citizen sensing data (e.g., pictures, videos, etc.), etc.

- Studies using social media scraping as a primary data collection method and another crowdsourcing method (usually Open Street Map, OSM) as a secondary dataset. Researchers believe such studies to be of importance as they demonstrate how crowdsourcing could complement other datasets.

2.2. Crowdsensing

Crowdsensing leverages the proliferation of low-cost sensing devices and citizen engagement for collecting and sharing data in different domains (environment monitoring, traffic management, waste management, etc.). Participation in crowdsensing can be voluntary or non-voluntary. For example, a crowdsensing application can combine sensing data (e.g., GPS data) with lobation-based service network datasets such as social media check-ins [31]. Thus, similar to social media, researchers will carefully identify the studies in which participation in crowdsensing is voluntary.

Web-based PPGIS has also been used to crowdsource data for urban planning [32]. Some Web-based PPGIS projects provide an online platform where participants can share local knowledge through open calls, which is consistent with the basic principles of crowdsourcing.

Therefore, in line with the arguments discussed above, researchers adopt a broader definition of crowdsourcing which covers voluntary crowdsensing, dedicated social media campaigns, and collaborative websites (web-based PPGIS, collaborative mapping, and idea generation).

3. Main research areas

3.1. Urban Morphology

These studies use data shared by the public to examine the urban forms, their formation, and evolution, as well as their impact on different aspects of urban life. The main elements of urban forms investigated in the reviewed papers are land use, infrastructures, and housing. The GS experiences fast urbanization which negatively affects the aforementioned elements, and strong measures need to be taken in order to overcome the challenges. In terms of land use, studies in the GS focused on the classification of functional zones so as to determine the main areas where human activities usually occur [33][34][35]. Such studies are important for the GS as they can help, among others, detect rapid urbanization and can therefore help better manage the existing resources. Crowdsourcing is, in this case, a source of training datasets for the classification algorithms. Regarding infrastructures, they should be a major domain of investigation due to the lack of basic infrastructure in many areas of the GS [36]. Some studies investigated the effects of the road network on cyclist behavior [37]. Studies on urban design focus on the effects of the urban landscape and street configuration on human activities and/or behavior. For example, Mohamed & Stanek [30] examined the effects of street configuration on sexual harassment, while other researchers analyzed the impact of the urban landscape on physical activities [38][39]. Such studies can help guide future urban design so as to build safer, more equitable, and healthier urban environments. Regarding housing, it has been a major cause of concern in the GS, mainly due to the lack of affordable housing and the proliferation of informal settlements. Sub-Saharan Africa has the highest proportion of slums in the world (50.2%), followed by Central and Southern Asia (48.2%) [40]. To tackle these challenges, some studies have involved the public in the mapping of informal settlements in the GS. However, they usually rely on the most basic forms of community mapping with paper drawings and limited sample sizes [41][42]. With the proliferation of smartphones in some parts of the GS, more advanced methods through crowdsourcing could help reach larger samples.

3.2. Urban Transportation

Due to its importance and several implications on different aspects of urban life, transportation is among the most represented areas among the reviewed papers (16 papers). The wide variety of domains covered also justifies the large number of papers in the reviewed literature. As a service designed for the public, transportation is heavily impacted by the way people behave through time and space as well as their response to different transportation-related services. Investigating travelers' behavior could help understand their impact on the urban space (e.g., through their travel patterns) and help draw more data-driven policies to support better transportation planning in the GS. In some cities of the GS, crowdsourcing has been used to examine users' travel behavior through travel patterns [43], route choice [44], travel behavior's impact on congestion [45], etc. Travelers' responses to mobility services as well as strategies to improve them were also investigated. Musakwa and Selala [46] used crowdsourced GPS data to investigate cycling patterns, while other studies developed multimodal or public transportation networks with crowdsourced data [47][48]. Other studies also focused on the traffic signal optimization [49], traffic density estimation [50], etc. Given the large number of social media users among young people, researchers have also looked for ways to involve the youth in transportation planning by crowdsourcing through dedicated social media pages.

3.3. Environmental Monitoring and Management

In an era of sustainable urban planning, research on how public engagement could foster the development of more sustainable cities has become a trend in some cities of the GS. This is also in line with the United Nations' 2030 agenda for sustainable development goals (SDGs) regarding sustainable cities and communities [51], which supports the improvement of urban planning in participatory and inclusive ways. For this reason, researchers have leveraged the power of public engagement through crowdsourcing to monitor the environment and, in some cases, develop decision support systems for both the public and decision-makers. The proliferation of smartphones has made this process easier as smartphones can capture and share data without any technical knowledge from the users. This made possible the collaborative collection of noise data [52], air temperature from smartphone batteries [53][54], the reporting of pollution of coastal zones [55], etc.

3.4. Data Collection and Optimization

These studies demonstrate the potential of crowdsourcing as a source of data for the GS as well as ways to optimize the data collection methods. For example, in China, several research efforts have developed new methods to increase the spatio-temporal coverage of voluntary crowdsensing tasks to obtain larger and more representative datasets while minimizing the cost and improving privacy. These methods include protecting participants' privacy, increasing the coverage distribution of sensing tasks through incentive mechanisms [56], and enhancing data forwarding performance through cooperative data forwarding mechanisms [57][58]. Taking into consideration the characteristics of the GS, other studies showed different solutions to involve the public in data gathering and experiment design [59]. Recently, there has been a growing trend on the potential for crowdsourcing as a data collection method for monitoring sustainable development goals (SDGs) in the GS. Pateman et al. [60]

provided a review on the use of citizen science for monitoring SDGs in low-and-middle-income countries, while Fraisl et al. [6] introduced a citizen science tool (Picture Pile) for monitoring SDGs.

3.5. Assessment of Crowdsourcing Methods for Urban Planning

Some studies have assessed crowdsourcing methods in the context of urban planning in the GS. Given the novelty of crowdsourcing in the GS, such studies are crucial when assessing its applicability and usefulness for cities in this part of the world. If most studies adopt a more objective approach using statistical evaluations (through the density, accuracy, nature of the crowd, etc.), others opt for a subjective method through users' perceptions (perceived usefulness, perceived ease of use, perceived satisfaction, etc.). The objective assessments mainly focused on collaborative mapping and were conducted in China [61][62], Turkey [63], Kenya [64], as well as cities in Argentina and Uruguay [65], most of them focusing on OSM. Regarding the subjective assessments, Cilliers & Flowerday [66] investigated the subjective factors affecting the intention to use the Interactive Voice Response (IVR) system in South Africa, while Bugs et al. [67] examined the perceived ease of use, perceived usefulness, and satisfaction with a Web-based PPGIS platform for urban planning in Brazil.

3.6. Smart City Management

Smart cities put the public at the center of the planning process. Therefore, participatory approaches such as crowdsourcing play an important role as they allow the public to share their ideas and opinions for more efficient planning practices. However, the GS is behind the rest of the world in terms of smart city management due to a lack of basic infrastructure and a clear understanding of what a smart city should be in local contexts. For this reason, crowdsourcing could start with an exchange on steps towards smart city transformation in the context of the GS. This is the method adopted by Kumar et al. [29], who crowdsourced ideas (idea generation) for smart city transformation in India. Another step would be to consult the public on the efficient management of the existing resources, as demonstrated by other studies in the GS [68].

3.7. Urban Demographics

The rapid population growth in many cities of the GS, especially African cities, raises some challenges which could be mitigated with data-driven methods. Such methods could help monitor the changes in the population, predict future trends and implement proactive policies to face future challenges. However, despite the potential advantages for the GS, urban population estimation has not been widely investigated in the area as all reviewed studies were conducted in China [69][70][71][72]. In the aforementioned studies, crowdsourcing (collaborative mapping through OSM) was adopted as supplementary open data so as to improve the accuracy of the mapping algorithms.

3.8. Disaster Detection and Management

If natural disasters are common in all regions of the world, the GS is particularly vulnerable to them due to the lack of resources for disaster detection and management. Crowdsourcing, especially collaborative mapping, has played an important role in helping the GS face these challenges. One of the main examples is the use of OSM for disaster relief during the 2010 earthquake in Haiti. Some studies have shown how public engagement can help improve flood mapping in the GS [73][74][75]. Crowdsourced data can supplement other datasets (e.g., wireless sensor networks data) to develop spatial decision support systems (SDSS) for flood management, as demonstrated by Horita et al. [75].

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