Resistance and Use of Crowdsensing Applications as a Communication Channel for Citizen Participation in Brazilian Smart Cities

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Abstract

Mobile device technologies are gaining increasing traction in the daily lives of citizens and cities. In this context, crowdsensing applications have facilitated data sharing in smart cities, serving as a channel for communication and civic engagement. Through citizen participation combined with technology, it becomes possible to support urban planning and resource management from the community's perspective. This research aimed to understand the reasons for citizens' use of and resistance to crowdsensing applications for smart cities as a form of communication. Furthermore, the study sought to identify, among active participants in these applications, the topics most frequently communicated to the responsible public sector agencies. The initial phase involved conducting in-depth interviews with 12 individuals active in digital profiles related to citizen participation in Florianópolis, SC, Brazil, to comprehend the reasons for both the utilization of and resistance to using crowdsensing applications for civic engagement. In the second phase, data was extracted from a crowdsensing system, the Participact application. The analyses, such as word cloud, word count, and clustering, were generated using text mining techniques in Python. Results showed that the lack of awareness about the existence of such solutions, disbelief in the tool's effectiveness in transmitting communication to government agencies, issues related to device usability are the main reasons why participants resist using these technologies. Once citizens use the applications, however, it is highlighted that pedestrians are the main information providers via the crowdsensing app. Some express concerns regarding the risks of illness, injury, and accidents, present a critical view of the public service providers, and possess knowledge spanning various fronts of administration, from gardening and suggesting improvements for traffic flow and accident prevention, to public asset maintenance, illicit pollution practices by businesses, and several others.

Keywords: smart cities; citizen participation; public engagement; communication; crowdsensing.

Introduction

With new technologies and the diffusion of innovation in the context of citizen participation, various resources are considered for the improvement of public spaces and the dynamics of cities. Mobile crowdsensing is a technology in which individuals with computational devices and sensors, such as smartphones, act to collectively share their data for the benefit of societal interests (Cecilia et al., 2020).

In this context, smart cities play an important role in integrating technology and agility to face challenges of urbanization and governance, as well as to enhance the quality of life for their citizens (Tezza et al., 2024). According to data from Statista (2024), the smart city sector in Brazil is estimated to grow at an annual rate of 11.87% from 2024 to 2029, primarily focused on the development of technology and Internet of Things (IoT) solutions.

According to Souad and Rafika (2022), citizen participation is characterized as the active involvement of city residents in collective projects, using knowledge to influence and improve the built environment and community dynamics. The types of citizen participation, whether formal or citizen-led, can either enhance democratic decision-making and accountability or become isolated experiments due to a lack of governmental integration, which significantly influences urban planning policies. Lin and Kant (2021) point out that new media have been widely used by governments and other organized groups to access public opinion, distribute information, and support civil participation in planning practices. However, they highlight that few studies seek to understand how the local context influences, as well as the extent to which tools like social media and applications can amplify citizens' communicative power.

In this context, users of crowdsensing applications have an essential role in the development of smart cities by actively participating as citizens, communicating their interests, and submitting data that supports urban planning and resource management. For instance, this occurs through the use of applications that facilitate urban mobility and infrastructure, such as notifying traffic congestion, accidents, and other incidents in real-time, like the Waze application; as well as reporting urban infrastructure problems to the public sector, such as potholes, broken lamp posts, and inadequate signaling, like the webapp Participact Brasil. This contribution is facilitated by technology and the IoT, relying on incentive mechanisms that ensure data quality and the engagement of those involved (Miranda et al., 2024).

Despite existing stimuli for citizen use and engagement, it is known that there are various barriers perceived by individuals when adopting crowdsensing applications in this context (Ma et al., 2024). Furthermore, once these barriers are overcome, it is essential to understand how and what topics are actually reported through this channel. This insight allows the public sector to implement more targeted marketing when promoting crowdsensing campaigns in cities (Chessa et al., 2020; Arian & Chiu, 2017).

This study aimed to understand the reasons for citizens' resistance to using crowdsensing applications for smart cities. Additionally, it sought to identify, among active participants in these applications, the topics most frequently communicated to the responsible public sector agencies, thereby gaining a broader understanding of their interests. To this end, a two-stage study was conducted: 1) In-depth interviews with 12 individuals active in digital citizen participation profiles in Florianópolis – SC – Brazil, considering the pre-existence of a

crowdsensing application with a citizen participation support function in the city, seeking to understand the reasons for resistance to using this and similar applications; and 2) Text and word frequency analysis of 975 reports/comments regarding urban problems submitted by users of the ParticipAct Brazil application database.

Theoretical Background

Smart Cities and Crowdsensing

By definition, the concept of smart cities emerged as a response to the speed of urbanization, encompassing sustainable practices (Ivanov and Nurmukhametov, 2019), integrated technological innovations (Dziundziuk, 2022), and public engagement through citizens (Čorejová et al., 2021).

Bastos et al. (2022) explain that, whether through social media or applications, citizens can communicate about urban issues continuously. The authors highlight the importance of considering joint approaches across these channels. According to Cezar (2019), through good public communication practices, marketing campaigns and strategies, whether traditional or digital, become known to citizens, thereby allowing active participation in their development. On the other hand, Höffken and Streich (2013) point out that, compared to traditional participation methods, digital channels tend to be more accessible to most citizens, as communication is done via smartphone, through so-called mobile participation. Along these lines, users of crowdsensing applications stand out in supporting the development of smart cities. Engagement is facilitated by technology and the IoT, through incentive mechanisms that expand the possibilities for individual participation and ensure the quality of the data collected, as per Miranda et al. (2024).

Citizen Participation, Incentive Mechanisms, and Engagement Attitudes

Citizen participation plays an essential role in the promotion and analysis of public problems, engaging individuals to actively position themselves and express their opinions (Baghat and Kim, 2022). For Souad and Rafika (2022), citizen participation is characterized as a form of involvement of city residents in collective projects, using their knowledge to improve the built environment and the common context. The authors point out that citizen participation initiatives can both enhance democratic decision-making and accountability and become isolated experiments lacking governmental integration.

The research by Ogie (2016) elucidates that different types of incentive mechanisms exist that cause people to engage in crowdsensing tasks. Furthermore, the author notes that the user's perception of the campaign's relevance to the target audience allows for increased participation, driven by social incentives. Conversely, studies assert that apprehension related to data privacy (Ma et al., 2024), the time availability of participants to perform tasks (Yang et al., 2023), and the mere lack of incentives from promoters (Zeng et al., 2024) are reasons why citizens do not engage in such applications.

Mollen and Wilson (2010) state that engagement is composed of the dimensions of active sustained cognitive processing, instrumental value (utility and relevance), and experimental value (emotional congruence), while Kim et al. (2013) explain that the state of mobile user engagement moves through the cognitive stage, affective stage, and conative stage, and is achieved according to hedonic, social, and utilitarian motivations. Therefore, it

is valuable to deepen and adapt the studies on the emotional, cognitive, behavioral, conative, and social aspects already raised by prior engagement research to the crowdsensing context.

Method

This research is characterized as mixed-methods and exploratory, encompassing a qualitative phase and a quantitative phase. In the qualitative phase, aiming to understand the reasons for citizens' resistance to and use of crowdsensing applications, semi-structured interviews were conducted both in person and online with 12 individuals who followed social media profiles that stimulate citizen participation in Florianópolis, Santa Catarina, Brazil. As profiles for public participation in the urban sphere we considered Instagram accounts from neighborhood groups, municipal government, and informational profiles that engage the population in civic participation.

The interviews were conducted in December 2024. Participants were between 23 and 44 years old, included both men and women, and held a university degree. The study employed convenience sampling using an interview script developed based on the work of Lin and Kant (2021), Ogie (2016), Leppälä (2018), and Jungstrand and Ceco (2017), which analyzed the use of new media for citizen participation, incentive mechanisms for mobile crowdsensing applications, and the phenomenon in the context of smart cities. For transcriptions, the Transkriptor AI tool was used. Subsequently, Bardin's (2011) content analysis was applied to interpret the data, with support from the Atlas TI software.

In the second stage, which aimed to understand the topics of interest among participants engaged in using the app, data was extracted from a crowdsensing system, the Participact application. The text of the comments was reviewed via Microsoft Excel, including spelling adjustments, exclusion of duplicates, and definition of the interest groups for analysis. The interest groups were defined according to areas linked to municipal public management, such as infrastructure and maintenance, environment and sustainable development, and health and education. After the review and definition of the interest groups, the Excel file was included in the project to be processed in PyCharm. The analyses, such as word cloud, word count, and clustering, were generated using text mining techniques in Python language code with the packages *'pandas'*, *'nltk'*, *'matplotlib'*, *'sklearn'*, *'scipy'*, *'spacy'*, and *'wordcloud'*; finally, Excel was used again to generate the descriptive charts of the word frequency for the interest groups.

Results and Discussion

In the first stage, following the interviews' data analysis, four categories were identified: Motivations for engagement in citizen participation profiles on social media; Self-perception regarding engagement in citizen participation issues; Experience and perceptions about crowdsensing tools; and Factors of resistance to the use of crowdsensing applications.

The analysis revealed that the main motivation for interaction in civic profiles is the informative nature of these channels, notably the search for news and updates about the community, urban infrastructure, and local events that directly impact daily life. Corroborating Kleinhans et al. (2015), active engagement, while present, is driven by an individual's personal connection to the theme, such as environmental issues or neighborhood

improvements. However, a cautious form of interaction on social media was observed, often due to resistance to exposure and fears of becoming involved in polarized discussions.

Regarding the self-perception of civic engagement, most interviewees express a critical and modest view of their own participation, generally not considering themselves actively engaged. Nevertheless, their daily actions demonstrate a concern for the environment and the collective good, such as proper waste disposal, suggesting that their behavior may be convergent with civic engagement, even if their self-perception does not reflect it (Mohr Carley et al., 2023). Furthermore, the research evidenced the influence of professional role on engagement perception, with some participants feeling more involved in citizen issues due to their field of work.

Concerning crowdsensing tools for citizen participation, a positive view emerged regarding this technology's potential for communication with public agencies and the resolution of urban problems, overcoming the sluggishness of traditional governmental portals. However, the practical use of these tools is low, with the lack of awareness of the existence of such solutions being a primary factor of resistance.

Additionally, the research identified four key factors of resistance to the use of crowdsensing applications: lack of knowledge about the tools; disbelief in the effectiveness and problem-solving capacity of the tool, where the citizen doubts the real impact of their contributions; usability issues, involving the search for practical and intuitive solutions; and, to a lesser extent, perceived financial or social impacts. These findings suggest that, to expand technology-mediated civic engagement, promotion and demonstration of results, as well as participation value, are imperative, mitigating distrust and validating the purpose of these platforms, as suggested by Ogie (2016) and Perera et al. (2014).

In the second stage, the results stemmed from the text mining analysis of 975 comments extracted from the database of the system, which is populated by citizen reports via the ParticipAct Brazil application from 2018 to 2025. The comment texts showed a total number of 4,364 distinct words. The word cloud in Figure 1 illustrates the result of counting the most frequent words related to the situations/problems reported on the website. The word "rua" (street) is the most frequent, followed by words such as "calçada" (sidewalk), "falta" (lack/missing), "buraco" (hole), "buracos" (holes), "ônibus" (bus), and "via" (road/way).

Figure 1. Word Cloud
Source: Original research results (2025).

The word cloud offers clues regarding the adjectives, nouns, and verbs used to characterize the comments. This provides the basis for further text mining analyses, helps in segmenting groups for more detailed analysis, and offers more information about the texts. Additionally, we found the 100 most frequent words in the Participact reports and their respective counts. To illustrate, we present the 10 most frequent words in citizen reports on the application: street (268), sidewalk (103), missing (72), manhole (69), manholes (65), bus (61), lane (61), pedestrian (57), litter (53), and front (53).

We identified the presence of several nouns related to the complaints, such as 'pedestres/pedestre' (pedestrians/pedestrian), 'moradores' (residents), 'pessoas' (people), 'prefeitura' (city hall), 'crianças' (children), 'calçada' (sidewalk), 'rua' (street), 'praça' (square), and 'estacionamento' (parking). Some verbs indicate urgent actions needed in the comments, such as 'risco' (risk), 'perigo' (danger), and 'acidente' (accident), in addition to adjectives that qualify the public service/asset, like the word 'quebrada' (broken).

Our analysis also indicated the words most used to describe the comments. Starting with the word 'rua' (street), which is typically used to describe situations occurring in crowdsensing apps, it shows frequency similarity with words like 'lixo' (litter), 'buracos' (manholes), 'via' (road/lane), 'falta' (missing), 'pedestres' (pedestrians), 'buraco' (hole), 'local' (location), 'calçada' (sidewalk), 'ônibus' (bus), and 'bairro' (neighborhood). Based on this, it is possible to note that the word 'pedestres' (pedestrians) is prominent, indicating that active app users tend to be pedestrians; thus, reports are typically presented from this group's point of view. Furthermore, the comments concentrate on problems related to trash, potholes in public roads, and bus service.

Following the demonstration of the frequency of the most used words in the comments, and for deeper analysis, this next part involved the pre-selection of fields of interest: 'patrimônio público/serviço público' (public asset/public service), 'atores' (actors), 'lugares' (places), 'tempo/gravidade' (time/severity), and 'melhorias' (improvements). In the texts, it is common for citizens to use different terms with similar meanings for a field of interest. For example, the field of interest 'lugares' (places) was defined to include comments mentioning the interest words: 'praça/pracinha' (square/small square), 'parque' (park), 'túnel' (tunnel), 'rua' (street), 'br' (federal highway), 'via' (road), among others. By combining other words of interest for studying the 'places' field, it is possible to extract more comprehensive information about the study object. Table 1 presents the relationship between the fields of interest, the words of interest, and the count of comments that mention these words and fields of interest.

Table 1. Fields of interest and number of comments

Field of interest	**Words of interest**	**Comments Number**
Actors	pedestrians: 57, drivers: 22, authorities: 7, residents: 21, CASAN: 22, parents: 5, daycare: 14, wheelchair user: 8, passenger: 1, driver: 4, company: 11, guard: 6, resident: 7, cyclist: 3, wheelchair users: 10, blind people: 1, staff: 4, pedestrian: 16, elderly people: 8, COSATEL: 2, CELESC: 3, commerces: 8, company: 2, supermarket: 2, neighbor: 2, owner (female): 1, attendant: 1, young people: 1, COPASA: 1, elderly woman: 2, son/child: 4, minors: 1, tourist: 1	154

Places	street: 268, access road: 25, corner: 27, BR (Federal Highway): 3, stream: 10, road: 61, beach: 14, daycare: 14, sea: 12, overpass: 9, park: 18, lane: 26, school: 14, parking lot: 16, lot: 17, river: 15, airport: 4, terminal: 5, bike path: 17, college: 5, bridge: 13, landfill: 2, mangrove: 5, cloverleaf: 5, cycle lane: 2, tunnel: 7	413
Public Assets	lid: 24, sidewalk: 103, asphalt: 20, litter: 53, stop: 35, bus: 61, wiring: 6, stop: 7, wall: 1, channel: 3, paving: 8, water: 42, benches: 1, furniture: 1, shelter: 7, ground: 7, lighting: 21, stop: 5, sewage: 50, tree: 10, iron: 3, flowerbed: 5, cables: 3, parking lot: 16, pavement: 4, manhole: 20, manholes: 4, lot: 17, protection: 9, signaling: 3, ramps: 1, signaling: 26, elevator: 1, bench: 1, bathroom: 2, bars: 2, pole: 16, stones: 5, trash bin: 5, toys: 7, floor: 5, piping: 5, wall: 9, footbridge: 13, boxes: 3, step: 3, plumbing: 1, pipe: 7, roof: 3, fence: 3, network: 20, gas: 1, cone: 1, staircase: 1, mobile/movable: 2, material: 2, paver/tile: 1, wires: 5, stairs/ladder: 2, court: 3, speed bump: 7, parking spaces: 3, internet: 2, light bulb: 4, poles/posts: 6, ducts: 1, marquee/canopy: 1, hardware: 1, tables: 1, chairs: 1, pillars: 5, bars/railings: 2, showers: 1, signs: 7, fencing: 1, ceiling: 1, tube: 1, hose: 1	511
Risk	accident: 9, risk: 34, dangerous: 9, serious/severe: 4, emergency: 3, danger: 16, died: 1, fear: 2, injuring: 2	72
Weather	water: 42, rain: 15, stormwater: 7, wind: 3	58
Urban Enhancements	painting: 4, installation: 8, maintenance: 25, drainage/flow: 5, lighting: 21, pruning: 2, collects: 1, tree-lined: 2, signage: 26, elevator: 1, revitalization: 3, cleaning: 7, fix: 3, repair: 1, repaired: 3, preservation: 1, would flow: 1, collection: 1, cut/cutting: 3, ramp: 8, lowering: 1, flowers: 3, foliage: 1, helmet: 1, silence: 1, repair: 2	123

Source: Original research results (2025).

Figure 2 presents the graph of the fields of interest:

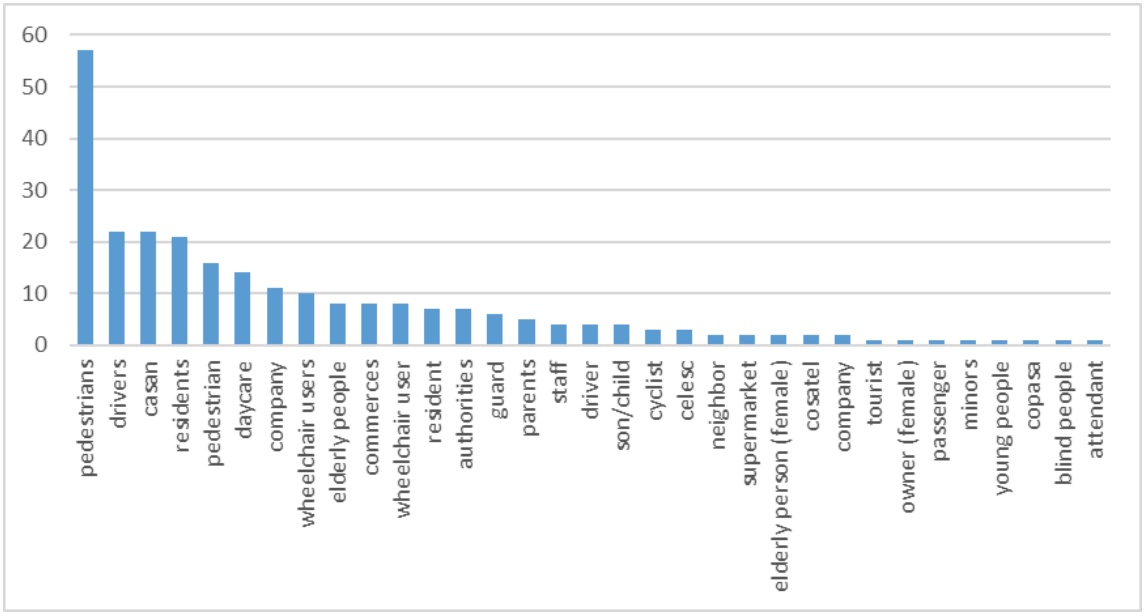

Figure 2. Mention of city actors in the comments
Source: Original research results (2025).

The charts contribute to the visualization of what is frequently reported in the urban sphere. However, it is also important to consider, especially concerning the characterization of actors, those who are rarely seen in terms of providing solutions beyond the obvious. Through text analysis, it was possible to identify the most present actors and, consequently, reflect on how to improve the participation of the absent ones.

Also, Figure 3 shows categories of places that are commonly mentioned in the comments. It is important to have a view of the places addressed because, for public data, geographic granularity must also be considered to understand what is happening in the cities, from central areas to more remote regions.

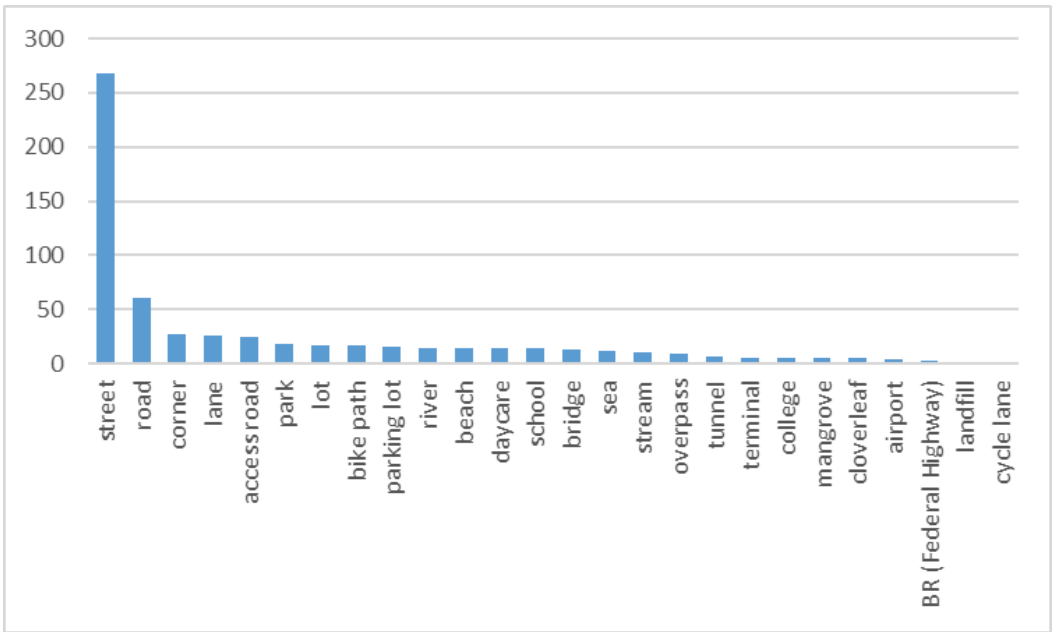

Figure 3. Mention of city places in the comments
Source: Original research results (2025).

Additionally, Figure 4 presents the public assets or public services related to the problems/situations typically reported in crowdsensing apps. This analysis reveals that citizens contribute to generating a "catalogue of assets" for the city, which managers, citizens, and third-sector organizations can use to initiate actions for maintenance or possible intervention regarding the problem/situation.

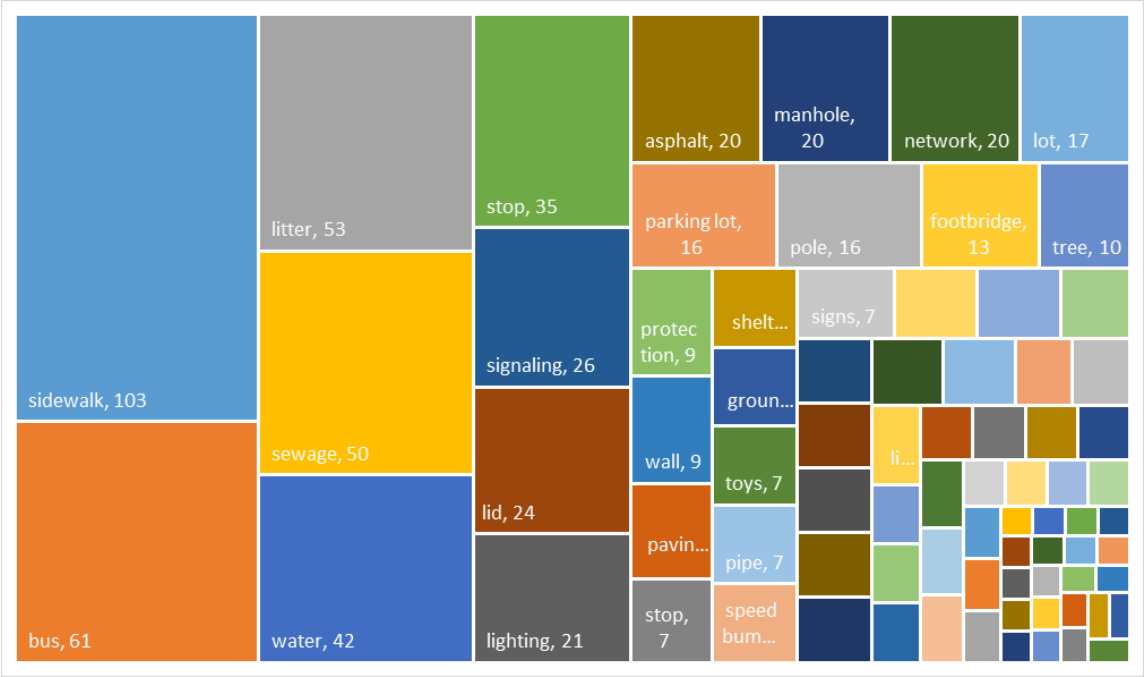

Figure 4. Mentions regarding public items and services in the comments
Source: Original research results (2025).

Broadly speaking, text analysis in crowdsensing apps is essential for uncovering information that goes unnoticed from the perspective of smart city managers and that does not appear in indicators or other types of quantitative variables. Citizens possess knowledge that should be recognized; the texts provide a better context of the situation and often offer suggestions for solving problems that go beyond the obvious. Based on the analysis of the ParticipAct database, it was possible to map the involved actors, places, and the main public assets/services. We can also identify situations requiring priority based on the texts, as they involve the risk of illness, injury, or accident. Climate change is an emerging theme, and it was possible to identify related factors within the text. Finally, we verified words of interest that indicate improvements, showing that the texts allow for the differentiation between comments that only describe the problem/situation and those that also point to improvements/solutions.

Conclusion

Citizen participation is taking on new forms with the rise of technological solutions that support the smart city scenario. In this context, crowdsensing tools have been explored and are considered a viable option for civic engagement. This research aimed to understand

citizens' use of and resistance to crowdsensing applications for smart cities, as well as identify the main topics of interest in the users view. We found that participants consider themselves to be minimally engaged, limiting their actions to basic practices such as waste separation. This perception is accompanied by distrust regarding the effectiveness of collective actions and the responsiveness of authorities, which suggests a significant barrier to more active civic engagement using crowdsensing tools.

Critical factors that lead to resistance to the use of this technology include the lack of information dissemination about crowdsensing applications in the community, disbelief in the tools' effectiveness in bringing about city improvements, application usability issues, as well as potential financial and social impacts resulting from their use. Additionally, in phase two, we applied an analysis of the ParticipAct database and mapped the involved actors, places, and the main public assets/services. We also identified situations requiring priority based on the texts, as they involve the risk of illness, injury, or accident. As an emerging theme, we can point out climate change.

The results underscore the importance of creating an environment that promotes active participation and recognizes individual contributions. It is noted that trust in digital technologies and the effective response from both the device provider and the authorities are crucial for increasing civic engagement. These insights are relevant to the field of study, as they indicate that, to foster citizen participation, it is necessary not only to make tools available but also to ensure they are effective and that the community is heard. Furthermore, they highlight the topics of interest for the community analyzed regarding active civic reporting on new media.

References

Arian, A.; Chiu, Y.-C. 2017. Evaluating the Promotion of Innovative Mobility Options with an Agent-Based Modeling and Simulation Approach. Transportation Research Record 2645(1): 176-183.

Bardin, L. 2011. Análise de conteúdo. Edições 70, São Paulo, SP, Brasil.

Bastos, D.; Fernández-Caballero, A.; Pereira, A,; Rocha, N. P. 2022. Smart City Applications to Promote Citizen Participation in City Management and Governance: A Systematic Review. Informatics 9(4): 89.

Cecilia, J. M.; Cano, J. C.; Hernández-Orallo, C.; Calafate, T.; Manzoni, P. 2020. Mobile crowdsensing approaches to address the COVID-19 pandemic in Spain. IET Smart Cities 2(2): 58-63.

Cezar, L. C. 2019. Comunicação e marketing no setor público: diferentes abordagens para a realidade brasileira. ENAP, Brasília, DF, Brasil. Disponível em: < https://repositorio.enap.gov.br/bitstream/1/4279/1/3_Livro_Comunica%C3%A7%C3%A3o%20e%20Marketing%20no%20Setor%20P%C3%BAblico%20diferentes%20abordagens%20para%20a%20realidade%20brasileira.pdf>. Acesso em: 22 de mar. 2025.

Chessa, S.; Foschini, L.; Girolami, M. 2020. Understanding Human Mobility for CrowdSensing Strategies with the ParticipAct Data Set," GLOBECOM 2020 - 2020 IEEE Global Communications Conference, Taipei, Taiwan, p. 1-6.

Čorejová,T.; Haľamová, E.; Madleňák, R.; Neszmélyi, G. I. 2021. The concept of smart city and the perceptions of urban inhabitants: a case study from Žilina, Slovakia. Hungarian Geographical Bulletin 70(2): 113-128.

Dziundziuk, K. 2022. The Concept of a Smart City in the Context of Modern Research. Theory and Practice of Public Administration 1(74): 63-78.

Höffken, S.; Streich, B. 2013. Mobile Participation: Citizen Engagement in Urban Planning via Smartphones 199-225. Disponível em: <https://www.researchgate.net/publication/291749584_Mobile_Participation_Citizen_Engagement_in_Urban_Planning_via_Smartphones>. Acesso em: 21 de novembro, 2024.

Ivanov, V. V.; Nurmukhametov, R. K. 2019. The Smart City concept: discussion points. Management and Business Administration 15-26.

Jungstrand, A.; Ceco, P. 2017. Succeeding with Smart People Initiatives: Difficulties and Preconditions for Smart City Initiatives that Target Citizens. Dissertação de Mestrado. Lund University, Lund, Suécia. Disponível em: <https://www.lu.se/lup/publication/8910578>. Acesso em: 13 out. 2024.

Kim, Y.; Kim, D. J.; Wachter, K. 2013. A study of mobile user engagement (MoEN): Engagement motivations, perceived value, satisfaction, and continued engagement intention. Decision Support Systems 56: 361-370.

Kleinhans, R.; Van Ham, M.; Evans-Cowley, J. 2015. Using Social Media and Mobile Technologies to Foster Engagement and Self-Organization in Participatory Urban Planning and Neighbourhood Governance. Planning Practice and Research 30: 237-247.

Leppälä, L. 2018. Understanding the current trends in mobile crowdsensing - a business model perspective: case MyGeo Trust. Dissertação de Mestrado. Aalto University. School of Business, Espoo, Finlândia. Disponível em: < https://aaltodoc.aalto.fi/server/api/core/bitstreams/e7a2507b-ab7a-41cf-8c0d-a876ae5a5566/content>. Acesso em: 02 dez. 2024.

Lin, Y.; Kant, S. 2021. Using Social Media for Citizen Participation: Contexts, Empowerment, and Inclusion. Sustainability 13(12): 6635.

Ma, C.; Xu, Y. 2024. FedCrow: Federated-Learning-Based Data Privacy Preservation in Crowd Sensing. Applied Sciences 14(11): 4788.

Miranda, R.; Alves. C.; Sousa, R.; Chaves, A.; Montenegro, L.; Peixoto, H.; Durães, D.; Machado, R; Abelha, A.; Novais, P.; Machado, J. 2024. Revolutionising the Quality of Life: The Role of Real-Time Sensing in Smart Cities. Electronics 13(3): 550.

Mohr Carney, M.; Adams, D.; Mendenhall, A.; Ohmer,M. 2023. Civic engagement: An antidote to desperation? Journal of Community Practice 31(2): 121-126.

Mollen, A.; Wilson, H. 2010. Engagement, telepresence and interactivity in online consumer experience: Reconciling scholastic and managerial perspectives. Journal of Business Research 63(9-10): 919-925.

Ogie, R. I. 2016. Adopting incentive mechanisms for large-scale participation in mobile crowdsensing: from literature review to a conceptual framework. Human-centric Computing and Information Sciences 6: 1-31.

Perera, C., Zaslavsky, A., Christen, P., & Georgakopoulos, D. 2014. Sensing as a service model for smart cities supported by internet of things. Transactions on Emerging Telecommunications Technologies 25(1): 81-93.

Souad, S. B.; Rafika, K. (2022). Citizen Participation: A Matter of Competency. European Journal of Social Sciences 5(2): 24-38.

Statista. 2024. Smart Cities – Brazil. Disponível em: <https://www.statista.com/outlook/tmo/internet-of-things/smart-cities/brazil>. Acesso em: 13 out. 2024.

Tezza, R.; Hochsteiner, P.; Kieling, A. P. 2024. ANÁLISE DE INDICADORES PARA CIDADES INTELIGENTES: uma revisão sistemática e proposta de agenda de pesquisa. P2P E INOVAÇÃO 10(2): 6879.

Yang, G.; Dongsheng, G.; Buye, W.; Xingyu, H.; Jiangtao, W.; Gang, W. (2023). Participant-Quantity-Aware Online Task Allocation in Mobile Crowdsensing IEEE Internet of Things Journal.10: 22650-22663.

Zeng, Y.; Liu, B.; Li, Y.; Giustiniano, D.; Banerjee, S. 2024. Sustainable Spectrum Crowdsensing. In: IEEE International Symposium on Dynamic Spectrum Access Networks, 2024, Washington, DC, USA.