Journal of Data Acquisition and Processing
ISSN: 1004-9037
https://sjcjycl.cn/
DOI: 10.5281/zenodo.98549723

PARTICIPATORY MAPPING OF INFORMAL SETTLEMENTS: A CROWDSOURCING APPROACH WITH MOBILE APPLICATIONS

Dr. Amandeep Kaur Gurna
Assistant Professor, Department of Geography, Baba Farid College, Deon

Amandeep Singh
Research Scholar, Department of Geography, Central University of Punjab, Ghudda

Abstract

The potential of web-based participatory mapping technologies for use in urban planning and the development of spatial information in Delhi's slums is explored in this article (barrios). While mapping technologies are becoming more popular in affluent nations, they are being used less often in the informal settlements of developing nations owing to problems associated with widespread informality, illegality, and a dearth of data, personnel, and capital. The purpose of this research was to develop a course for Sector-level planning officials in Delhi's slums that would use Google My Maps for participatory mapping. Our primary focus was on cataloguing and mapping existing and proposed public assets and infrastructure. This study's overarching goal is to demonstrate how such instruments may aid in the planning of informal settlements and the generation of locally created spatial information.

Key words: Web-based participatory mapping; Collaborative mapping; Informal settlements; Developing countries; Urban planning.

INTRODUCTION

In order to ensure the long-term prosperity of cities in the Global South, sustainable development frameworks—defined as "the processes by which people individually and collectively enhance their capacities to improve their lives according to their values and interests"—are essential. Challenges such as high rates of crime and economic inequality plague Latin American cities. While India takes center stage in the United Nations Human Settlements Program's most recent global city report, the report's prediction that 90% of Latin America's population would reside in urban areas by 2050 remains unchanged. Due to urban expansion, city sizes are growing at an alarming rate, often two- or three-fold faster than their respective populations. Countries in this area of the globe are seeing rapid population growth, particularly among the young, who are both the inheritors of serious urban issues and the most hopeful source of remedies. How can we encourage young people to take an interest in the city around them? How can we help them learn more about the urban issues they face so that they can begin to build solutions?

In this article, we discuss SenseCityVity, a programme that helps young people identify, catalogue, and reflect on the issues facing their community. Our method combines community

practices in which young people are in the "driver's seat" of urban involvement and perception with digital tools like mobile crowdsourcing and social media. Here, we share our insights gained from working with a large youth population in both laboratory and field settings, and we summaries the results of many data analysis aimed at gaining a deeper comprehension of how young people see issues in their immediate urban environments.

A clear picture at the municipal level of which areas are seriously under-serviced and which would instantly benefit from small, targeted repairs is important to enhance the living circumstances and economic opportunities of persons living in informal settlements. Using topological analysis, we may quantitatively evaluate how building footprints relate to the existing road network, albeit this conclusion is highly dependent on local issues. The number of construction lots that must be traversed in order to reach the current roadway network may be calculated using a topological strategy. By concentrating on maps' topological invariant qualities, we may study urban areas without devising methods predicated on specific morphology or visual hints, both of which are highly reliant on the surrounding environment and historical circumstances.

In this paper, we detail a massive computational approach for identifying shantytowns wherever on Earth. Open Street Map data is used to illustrate how topological studies may be applied to global datasets, with scenarios developed by the computer proposing minimum disruptive infrastructure modifications that would provide all buildings in informal settlements access to streets.

The absence of information and cooperation necessary to develop a corridor-level plan with a comprehensive strategy rather than a collection of isolated initiatives can be traced back in large part to ULC's separation from municipal and sub-municipal government organisations. We thought that by getting the community involved in collaborative mapping initiatives and by offering digital tools for analysis and data collecting, we might help alleviate the shortage of spatial data at the Corridor level. For two reasons, this knowledge about the corridors inside the city is particularly valuable since the city cannot plan at the micro-level of communes with an average population of 1,000. i) the city government, and ii) the communal councils and sectors, who may then factor in the interventions and initiatives of neighboring communities as they make their own plans. (Figure 1).

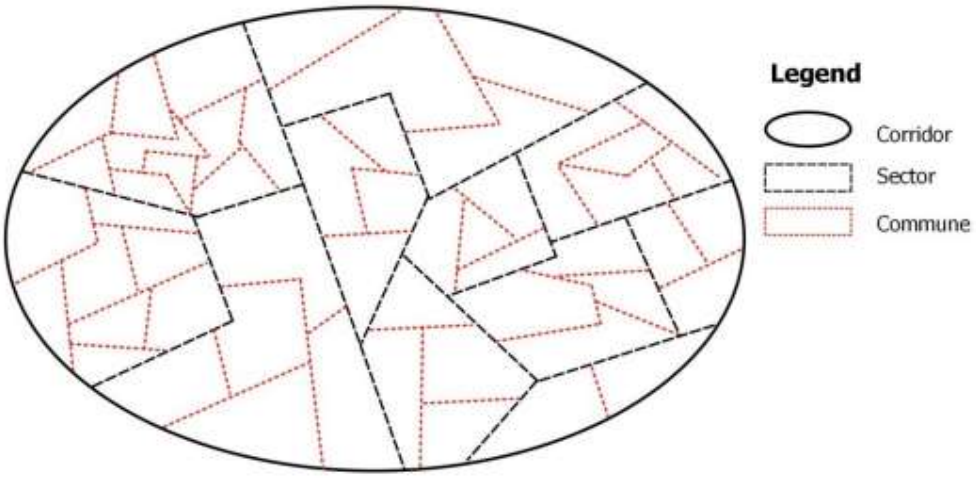

Figure 1 – Schematic Representation of the three-tier system involving Corridors, Sectors, and Communes.

LITERATURE REVIEW

Satej Soman, et al. (2020), New methods of citizen participation, urban planning, and service supply are made possible by the recent proliferation of high-resolution geographical data, particularly in growing metropolitan areas. Growing cities often lead to the development of slums, which is both a promising and pressing issue. Too frequently, inhabitants and towns in these areas suffer from a lack of social and economic networks connecting them. We demonstrate how one may assess the complexity and expense of accessibility problems, develop detailed floor layouts, and identify problem areas in terms of accessibility.

Tekouabou, S.C.K. (2022), In the Global South (GS), where a rising population and fast urbanization pose severe issues in the years to come, crowdsourcing may be of enormous assistance to the creation of sustainable cities. To reach this potential, however, it's crucial to account for the specifics of the GS and the difficulties that come with it. This research examines the potential technical, administrative, intellectual, socio-economic, and cultural barriers to the widespread implementation of crowdsourcing techniques for public engagement in urban planning in the GS. Some recommendations for further study and practise are also offered.

Pánek, J. (2018), E-government, e-planning, and e-participation have brought community involvement into the modern age. Citizens now have the means to make their opinions heard via the use of crowdsourcing mapping platforms, computer-aided web interviews, and public participation support systems. An online mapping platform was implemented at this paper's case study location in Jesenk, Czech Republic. Largest variations in responses were seen between younger and older age groups. The visual comparison would need to be confirmed by further statistical analysis, however.

Corbett, J., & Cochrane, L. (2018), It is well acknowledged that participatory and community mapping may help assist social transformation by identifying and conveying development needs. The potential of community and participatory mapping to effect good social change is

investigated in this chapter. Concurrently, we will examine the underlying beliefs about social mobilisation and transformation in order to expose the difficulties and restrictions that exist in their practical application. This chapter introduces practitioners and scholars to the benefits, procedures, and implications of community and participatory mapping as a communication tool for social change and development.

Klonner, C et al. (2021), New approaches and ideas that might explain the increase in flood casualties are receiving more attention as a result. Participatory techniques include citizens in reducing catastrophe risk, and their expertise and insights are invaluable. In order to collect local knowledge on floods in Eberbach (Baden-Wuerttemberg, Germany), researchers utilised sketch maps and questionnaires during their fieldwork there. The city of Eberbach, in southwest Germany, is often inundated by the Neckar River, thus technologies developed for studying urban flooding in Santiago, Chile, were used there. Forty people from the research region and the same number from a control area make up the study's empirical database. Each group has equal numbers of inhabitants and pedestrians. Participants were selected at random for this research, and questionnaires were utilised to learn about their demographics and the extent to which material possessions, including homes, impacted their views on risk. Property owners have a heightened awareness of danger since they are responsible for a bigger area than pedestrians are. The sketch maps' foundational maps were selected in part because of the flood kind. One overview map was adequate for river flooding, but another map with more detail was needed for urban flooding, allowing for the labelling of individual streets. The data collected may supplement reliable sources like flood modeling. The relationship between people, academics, and government officials is strengthened via this method.

Methods

Our approach for the SenseCityVity project consists of five key activities that allow for the integration of youth labour assisted by mobile and social technology in the urban environment of Delhi.

Mobile Crowdsourcing Application

We built an Android-based app to serve as a data collection tool for the project. While students were out mapping Delhi, the software secretly tracked their whereabouts and allowed them to snap photos and videos. All data generation was automated and kept in sync with our server in the background. In order to safeguard participants' privacy, the mobile app was disabled while the UDC was not in session. The standards of anonymized data management were met by the application of best practices in data acquisition.

Experiment Co-design

The mobile crowdsourcing experiment was created jointly by our research team and the participants. The co-design process took place over the course of four weekly workshops and study groups, during which time topics like ethical considerations; data protection, personal safety, urban planning, and the fundamentals of filmmaking and photography were discussed.

The sessions were designed to pique the interest of the volunteers so that they may help us overcome the obstacles of our mobile crowd sourcing experience. Teams at the previous workshop laid up an itinerary for the UDC's proceedings in chronological order. Instead of analyzing the city's good and bad features, teams were told to focus in on the former. Therefore, groups decided on one or two urban issues they wished to study and how they would go about doing so. Facebook and Twitter were included into the project to keep in touch with the student body and to gather new photographs via a designated route. Throughout the remainder of the article, the term "urban concern" will be used to refer to one of the urban issues that was brought up in the co-design sessions.

Collected data

Two hundred and seventy-seven student volunteers signed up for the UDC, of whom 177 took part in the online crowdsourcing experiment and 100 in the fieldwork. About one hundred extra volunteers (relatives, classmates, acquaintances, and instructors) took part in UDC events but did not register in advance. In addition, In all, the online crowdsourcing experiment yielded 14 short movies, 100 Facebook posts, 5,300 GPS coordinates, 9,027 assessments of urban sites, and 20 audio recordings of informal interviews. Using the Twitter API, the UDC was able to collect over 19,000 tweets including generic geotags in 2014.

Video-recorded Interviews

Out of the 380 films gathered in total at UDC, 200 are unstructured interviews with Delhi residents. Eighty of the interviews were conducted in an organized manner, with each participant (108 men and 72 women) being given the same set of three questions. (1) What are the city-dwellers of Delhi's most pressing concerns? (2) What are the main city issues you have to deal with? Thirdly, what potential answers are there to these issues? Each structured interview lasts around 6 minutes on average. The remaining 20 interviews were conducted orally rather than on camera at the request of the interviewees. Twenty of the recordings included discussions on city life.

Scenes from the City on Video

Participants in the Urban Design Collaborative also filmed 180 movies depicting urban challenges or experiences. The length of the movies gathered ranges from 20 seconds to 10 minutes. To get a sense of how students feel about their city, it's helpful to watch the about one-third of these films that contain commentary from the individual filming it. Students were able to get reacquainted with their city's material reality through the lens of their mobile devices thanks to this type of fieldwork, which requires direct interaction with people on the street.

Mapping urban concerns

One of the initial challenges, from a quantitative perspective, was to make heat maps to show where people were most worried about urban problems. These maps were produced via the use of density estimate techniques applied to GPS coordinates extracted from geo-tagged pictures

amassed during the UDC. Traditional neighbourhoods, plazas, ancient lanes, and key avenues are depicted in red in Figure 1a as the primary areas of concern. It's intriguing to speculate on how the UDC data stacks up against that of mobile social media platforms like Twitter, which are becoming more popular for city-level research [15]. When compared to data generated by compiling geo-tagged tweets for the same region (Figure 1b), the patterns shown by the UDC heat map are distinct. Numerous areas of Delhi where the UDC teams uncovered evidence of urban issues had minimal Twitter activity, whereas the city's tourist districts and the area around the main campus of the University of Delhi have significant activity, as could be predicted. Our method's utility as an auxiliary tool for mapping urban environments in emerging cities is shown by the possibility that areas of urban concern are technologically inaccessible in social media channels like Twitter.

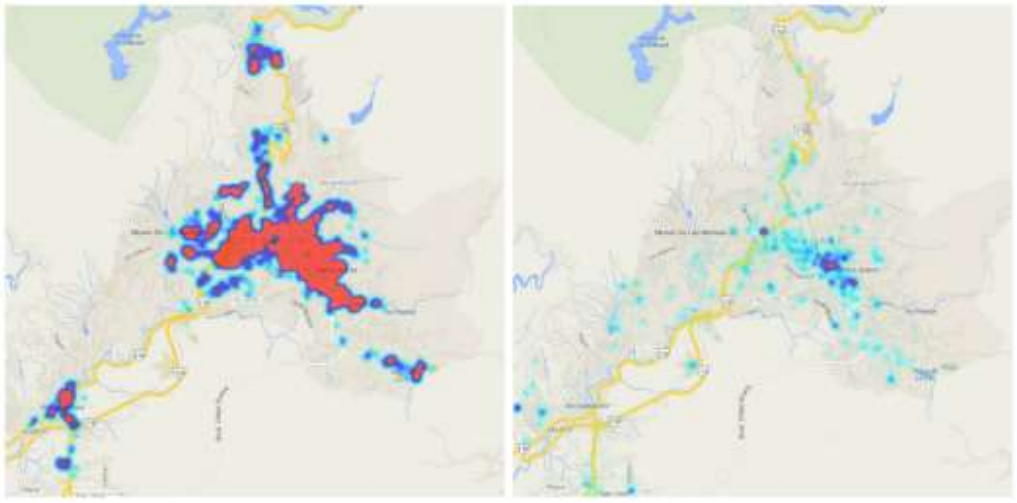

Figure 1 (a) The regions of concern (in red) are shown on a heat map derived from geo-localized UDC pictures. (b) Using geolocated tweets from regular Twitter users in Delhi, we were able to create a heat map.

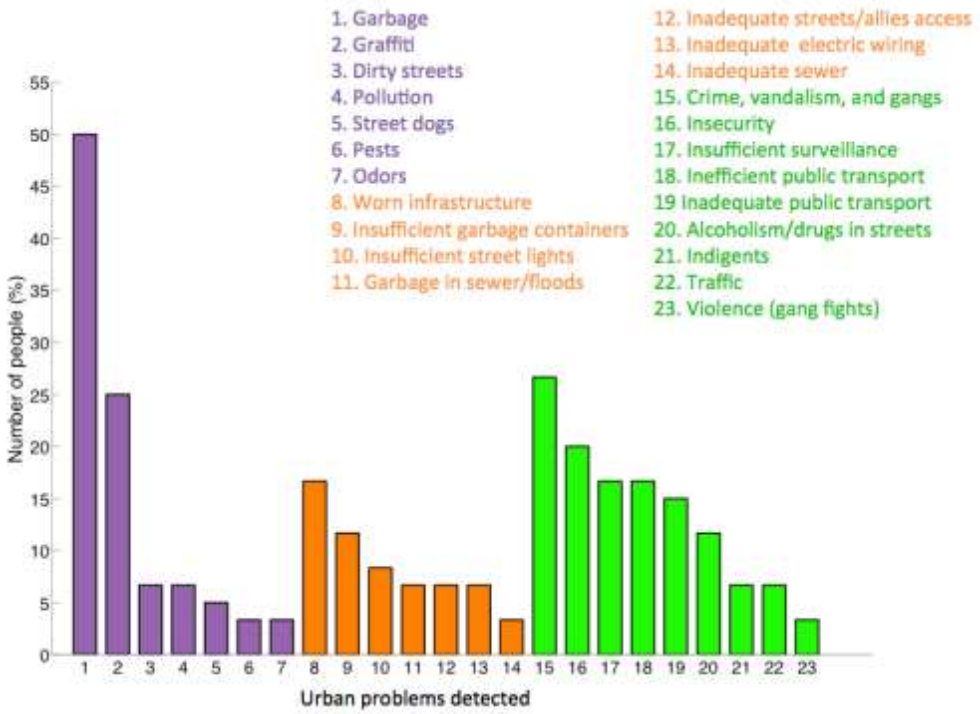

Figure 2. Participants in the UDC identified concerns in the urban environment, which they further classified into three groups: those pertaining to the city's image (purple), its infrastructure (orange), and its quality of life (green).

Emerging themes

To analyze the various themes recorded by UDC members and get insight into the present state of Delhi City. 1) Videos describing the city's appearance, featuring trash on the ground, graffiti, stray animals, etc. 2) Videos describing infrastructure issues, featuring insufficient street lights, garbage cans, and access to the streets; 3) Videos describing city life quality, featuring vandalism, alcoholism, drugs, and inadequate public transportation. Number of respondents who reported each issue type is shown in Figure 2.

Figure 2 shows that waste buildup and mismanagement are major problems that attract vermin, ruin the aesthetic quality of the city, and cause flooding and sewage backups, particularly during the wetter months. "the people in charge of collecting the garbage in the city are not able to do it on time, and the garbage containers often overflow, polluting the environment," say some residents. "... the garbage problem in the city is a people's problem," say others." As a society, we must do something about it. People worry about the city's deteriorated infrastructure in addition to the waste issue. High voltage electric cables are often positioned dangerously near to roofs, posing major risks to the public.

A majority of respondents felt less safe in their neighbourhoods and advocated for enhanced police presence on city streets and alleyways. The issue is that there is a lot of insecurity, in the alleyways, outside of the downtown centre," said one of the participants. People congregate in

the alleyways of the city late at night to drink and smoke marijuana. Every day, we'd play near the Hidalgo market. Unfortunately, we can't go outdoors as often as we'd want to because of our heightened sense of uneasiness.

Delhi City and the surrounding municipalities have seen rapid population increase over the last two decades, leading to more complicated urban mobility patterns and less than adequate public transit. One participant put it succinctly: " Issues with transportation to school, such as delays or limited availability, impact me personally and, I believe, the majority of students. While further study will include comprehensive image coding and analysis, a visual assessment of the geo-localized pictures reveals themes that are similar to those gathered by coding interviews and films. (Figure 2).

RESULTS

Participants in the training were able to create online maps of all 13 corridors of Delhi' Slums, each of which included numerous sectors, thanks to the web-based participatory mapping initiatives made possible by Google My Maps. Slum regions gained a wealth of spatial information and expertise thanks to the mapping of more than 4,000 characteristics. Public amenities like hospitals and smaller health clinics, parks, theatres and museums, marketplaces, and so on were mapped out, as were public areas like parks and plazas. Participants in the training programme also mapped the streets and neighbourhoods of Delhi's slums, as seen in Figure 3.

Corridor-level mapping initiatives are very useful since they pinpoint the precise locations of barrios' micro-projects like hospitals, schools, and sports arenas. Two specific Corridors are highlighted here as having achieved the most in terms of mapping features, sector coordinator participation, and workshop attendance. In addition, we detail the primary obstacles we encountered across all routes, which impose significant limitations on the mapping process.

DISCUSSION AND CONCLUSION

By applying Google My Maps to Delhi's shantytowns and informal neighbourhoods, we were able to collect a wealth of data that will serve as the foundation for future planning efforts at the corridor level, which will take into account all sectors along a given route. For the most part, we have been working to enhance planning across different industries and communes by cataloguing and mapping public amenities and public projects and works. This will be facilitated by a mapping of the surrounding environment and the connection between the slum's sections and the neighbourhoods that border it.

The residents of emerging cities are hampered in their efforts to attain optimal circumstances for holistic development due to the cities' intricate patterns of urban expansion. Sense CityVity has shown that mobile crowdsourcing technology can be successfully co-developed and used in a local Mexican setting to help young people identify, record, and reflect on their particular urban challenges. This was accomplished via the incorporation of citizen-contributed data with quantitative and qualitative methodologies that indicate which current issues are more

commonly acknowledged or go unreported; where these problems are concentrated; and how the public sees its own urban environment. However, it is a good and important subject to consider what our suggested strategy means for launching similar campaigns to learn about Latin American cities and how research like this may be used to aid locals in finding solutions to pressing problems.

Our studies have split in two after we finished the first part of the project. To begin, we have spread our method over many municipalities in Delhi. Second, we have included individuals of all ages, from young adults to the elderly. The academic communities of Leon (Delhi State) and Merida (southern Mexico) have both lately accepted our technique. We'll be able to put our findings to the test in novel settings thanks to these new collaborations.

REFERENCES

1) Klonner, C., Usón, T.J., Aeschbach, N. *et al.* (2021), Participatory Mapping and Visualization of Local Knowledge: An Example from Eberbach, Germany. *Int J Disaster Risk Sci* **12**, 56–71. https://doi.org/10.1007/s13753-020-00312-8

2) Cochrane, L., Corbett, J. (2018). Participatory Mapping. In: Servaes, J. (eds) Handbook of Communication for Development and Social Change. Springer, Singapore. https://doi.org/10.1007/978-981-10-7035-8_6-1

3) Pánek, J. (2018). Participatory Mapping in Community Participation – Case Study of Jeseník, Czech Republic. *Quaestiones Geographicae, 37*, 151 – 162, DOI:10.2478/quageo-2018-0031

4) Diop, E.B.; Chenal, J.; Tekouabou, S.C.K.; Azmi, R. (2022), Crowdsourcing Public Engagement for Urban Planning in the Global South: Methods, Challenges and Suggestions for Future Research. Sustainability, 14, 11461. https://doi.org/10.3390/su141811461

5) Satej Soman, Anni Beukes, Cooper Nederhood and Nicholas Marchio and Luís M. A. Bettencourt (2020), Worldwide Detection of Informal Settlements via Topological Analysis of Crowdsourced Digital Maps, International Journal of Geo-Information, volume 9, 685; doi:10.3390/ijgi9110685

6) Andreasen, M.H.; Agergaard, J.; Kiunsi, R.B.; Namangaya, A.H. Urban transformations, migration and residential mobility patterns in African secondary cities. Geogr. Tidsskr.-Dan. J. Geogr. 2017, 117, 93–104.

7) Makau, J.; Dobson, S.; Samia, E. The five-city enumeration: The role of participatory enumerations in developing community capacity and partnerships with government in Uganda. Environ. Urban. 2012, 24, 31–46.

8) Brelsford, C.; Martin, T.; Hand, J.; Bettencourt, L.M. Toward cities without slums: Topology and the spatial evolution of neighborhoods. Sci. Adv. 2018, 4, eaar4644.

9) Kit, O.; Lüdeke, M. Automated detection of slum area change in Hyderabad, India using multitemporal satellite imagery. ISPRS J. Photogramm. Remote Sens. 2013, 83, 130–137

10) Kuffer, M.; Pfeffer, K.; Sliuzas, R. Slums from Space—15 Years of Slum Mapping Using Remote Sensing. Remote Sens. Rev. 2016, 8, 455.

11) Mahabir, R.; Croitoru, A.; Agouris, P.; Stefanidis, A. A Critical Review of High and Very High-Resolution Remote Sensing Approaches for Detecting and Mapping Slums: Trends, Challenges and Emerging Opportunities. Urban Sci. Rev. 2018, 2, 8.

12) Mahabir, R.; Agouris, P.; Stefanidis, A.; Croitoru, A.; Crooks, A.T. Detecting and mapping slums using open data: A case study in Kenya. Int. J. Digit. Earth 2020, 13, 683–707.

13) Brown-Luthango, M.; Reyes, E.; Gubevu, M. Informal settlement upgrading and safety: Experiences from Cape Town, South Africa. J. Hous. Built Environ. 2017, 32, 471–493.

14) Zia, M.; Cakir, Z.; Seker, D.Z. Turkey OpenStreetMap Dataset - Spatial Analysis of Development and Growth Proxies. GeoScape 2019, 11, 140–151.

15) Yao, Y.; Liu, X.; Li, X.; Zhang, J.; Liang, Z.; Mai, K.; Zhang, Y. Mapping Fine-Scale Population Distributions at the Building Level by Integrating Multisource Geospatial Big Data. Int. J. Geogr. Inf. Sci. 2017, 31, 1220–1244.