16 Mapping Invisible and Inaccessible Areas of Brazilian Cities to Reduce Inequalities

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Abstract

This account of the experiences of the first YouthMappers chapter in Brazil aims to present the work done by Mapeadores Livres UFPR focusing on the themes of accessibility (SDG 10 Reduced Inequalities) and favela mapping (SDG 11 Sustainable Cities and Communities), bringing as a transversal discussion of the quality of the geospatial data obtained collaboratively. Mapeadores Livres UFPR proposes to be a formative space in collaborative mapping, and the theme of favela mapping reinforces our character as an extension and research group and as a teaching group with the inclusion of this topic in the course developed. YouthMappers functions as an outreach project at the Universidade Federal do Paraná and is an interface between the universe of social organizations and their humanitarian projects and that of universities and their research topics.

Keywords

Inequalities · Digital invisibility · Accessibility · Methodology · OpenStreetMap · Favelas · Brazil

1 A Scenario of Digital Inequality

In the context of urban and regional planning, geospatial data is a useful tool that can be used in several ways, particularly for conducting spatial analysis for evaluating and predicting expansion and growth. Unfortunately, in developing coun-

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P. Solís, M. Zeballos (eds.), *Open Mapping towards Sustainable Development Goals*, Sustainable Development Goals Series, https://doi.org/10.1007/978-3-031-05182-1_16

tries like Brazil, where the combination of a very dynamic urban structure and the lack of investment in cartography results in a chronic dearth of information about the city, the integration of geospatial data in decision-making becomes quite challenging. This deficiency is even more severe when we think of data on informal settlements, such as favelas, or information of interest to populations chronically invisible to public authorities, such as people with disabilities. Favelas are spaces in cities characterized by the precariousness of their infrastructure, the social vulnerability of their population, and their informality. It is difficult to access geographic data from underrepresented precarious settlements on official maps. At the same time, these spaces demand information to make decisions about improvement projects on varied fronts. Accessibility is a fundamental element for guaranteeing human dignity in urban environments and a right guaranteed by law in Brazil by the statute for persons with disabilities and the statute for the elderly. However, the Brazilian reality concerning accessibility is far from ideal. The inadequacy of measures that would guarantee access to urban environments for several groups, especially wheelchair users, the elderly, and the visually impaired, is frequent.

An associated concern is the little capacity building of civil servants, professionals, and the general population on open geospatial data and tools for collecting and utilizing this vital information. This scenario increases inequalities in the country, creating a data gap in territorial management and limiting the full participation of society.

2 YouthMappers at the Federal University of Paraná

Mapeadores Livres, the YouthMappers chapter at the Federal University of Paraná (UFPR), arises from the research group *Laboratório Geoespacial Livre* that since 2012 works on open-source cartography and collaborative mapping, focusing on our reality as a developing country. The laboratory was created as part of the *Geo For All* network, a joint effort between the Open-Source Geospatial Foundation (OSGeo), International Society for Photogrammetry and Remote Sensing (ISPRS), and International Cartographic Association (ICA) to make spatial information available to everyone.

Fig. 16.1 The Mapeadores Livres UFPR chapter logo pays tribute to the flag of Brazil

Our team brings together undergraduate and graduate students, researchers, and professionals to expand the use and understanding of open, collaborative information in Brazil. In 2019, Mapeadores Livres became the first YouthMappers chapter in the country, and we expanded our projects in spatial data quality, slum mapping, and urban mobility. We research collaborative mapping in the abovementioned themes and produce text and video resources in the Portuguese language. These materials contribute to mappers' training in Portuguese-speaking countries and have supported the expansion of the YouthMappers' presence in Brazil. This chapter also develops partnerships with groups active in the chosen themes and creates open-source software to expand the mapping capacity and data availability on OpenStreetMap (OSM). More recently, we are promoting free remote courses to the community on mapping with open tools in the OpenStreetMap ecosystem. We aim to expand the mapping community and foster those in Portuguese-speaking countries. In order to make the resources our team has created, some of the courses that Mapeadores Livres have offered can be found on the chapter's YouTube channel.

As seen in Fig. 16.1, the Mapeadores Livres UFPR chapter logo is a modification of the YouthMappers logo and features the colors of the Brazilian flag. The hemisphere of the globe is in

South America; the marker is a stylized pine nut (the pine nut is an edible seed typical of the region), which is the symbol of the city of Curitiba, where the group is based.

3 Systematized Collaborative Mapping

In these nine years of history, dozens of students, courses on free software, scientific articles, and open applications have been developed by the laboratory team. Turning our attention to the collaborative data of open platforms like OpenStreetMap was a natural passage in our teaching and research activities and an opportunity to interact with and impact communities more directly. From a research context on open spatial data, we began to dialogue with public institutions, receiving professionals such as analysts from municipalities and the National Mapping Agency (IBGE) to be part of our team to extend the idea of using collaborative information to help build up the geospatial data in the country.

We maintain a workflow for the organization of activities. The working theme of one or more members of the group or an external demand is what guides the workflow. The main stages are (1) an interdisciplinary meeting, (2) the production of training material, and (3) organizing a mapathon (Fig. 16.2).

The process begins with contacting the community acting in that region or theme and seeking to broaden the group's knowledge of concepts related to the issues being addressed. These spaces are either closed meetings or lectures open to the public. In these meetings, we also discuss the user's perspective on applying geospatial data to the topic under analysis.

We consider the creation of tutorials, videos, lectures, or courses to disseminate knowledge on the subject and make them available in different media, such as manuals on the chapter's website, social media, and audio or video through the group's YouTube channel. Tutorials, lectures, or short courses focus on specific themes or tools. Mapathons are the final step in our workflow cycle and are a space for dissemination, training, testing, and validation of systematized collaborative mapping processes. These are also opportunities to publicize our activities and strengthen the social ties that permeate the group. Following the mapathon, a new cycle of the workflow begins.

Prospecting for new themes is open at every workflow step, allowing the group to run multiple projects and cycles in parallel. The pandemic

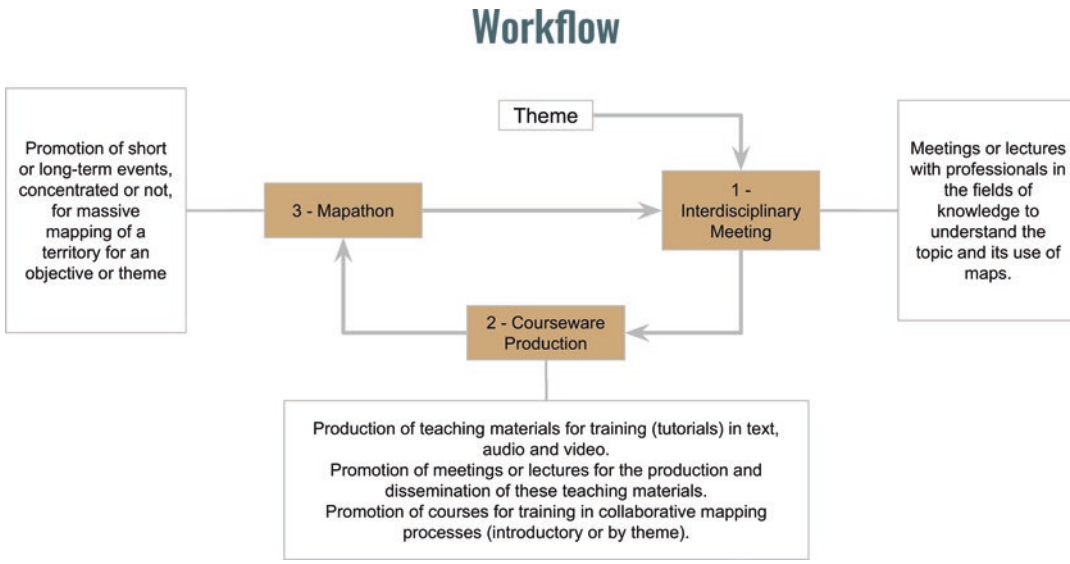

Fig. 16.2 A project workflow integrating remote and local mapping ensures quality, student learning and community engagement in YouthMappers activities

of COVID-19 had a rather significant and prolonged impact on the country. Our chapter was created in mid-2019, and within a few months, we would be under an extended regime of remote activities in Brazilian universities. This scenario was quite challenging for our group, but throughout 2020 and 2021, we managed to maintain our remote activities, even managing to expand the number of participants from other regions of Brazil. We believe that even with the return of face-to-face activities, the experience of this period will lead us to maintain, at least partially, the remote activities to minimize geographical barriers to the participation of interested participants.

4 Mapping Favelas

Favelas are spaces in cities characterized by their precarious and informal infrastructure and equipment and the social and economic vulnerability of its population (UN HABITAT 2003; Davis 2004; IBGE 2011; Cardoso 2016). In Brazil, 6%, or 11 million Brazilians, live in this condition (IBGE 2010).

Public authorities and service providers treat the favelas as informal and invisible spaces. Consequently, informality and invisibility by these institutions affect the lack of geographic information about the communities. In contrast, the number of people living in these spaces, the organic and self-built form of the communities, and the socioeconomic problems (e.g., livability, access to the so-called "formal" city, vulnerability, inadequate access to healthcare, environmental issues, and disaster risk) generate a demand for the information that is absent (Olthuis et al. 2015). Thus, the mapping of these spaces has enormous potential to meet the social demands of a significant group of people in the geographic clipping that marks several cities around the globe.

In contrast to the neglect of companies or even state entities, various social organizations map marginalized urban and rural areas. Some are the Humanitarian OpenStreetMap Team (HOTOSM); MAPKIBERA, in Kenya; and TECHO, more specifically, in Latin America. These social entities use distinct processes, including collaborative mapping techniques and tools such as OpenStreetMap (Bortolini and Camboim 2019). Therefore, they show interest and use approaches that are not the traditional ones.

The approach to collaborative favela mapping in the project considers the presentation of best practices. These include the correct acquisition of features considering three essential points: (1) completeness of the features, including geometry, (2) topological relationship between feature geometries, and (3) thematic and attribute completeness. Thus, we describe them in some detail (Fig. 16.3).

4.1 Ensuring Quality in Data Collection

Geometric completeness deals with the acquisition of all features in a given area. If it is not possible to capture all features, it is necessary to consider prioritizing them. For favelas, one way to list information categorically, in order of priority for acquisition, is as follows: buildings, roads, hydrography and other drainage features, points of interest and land cover, and vegetation features. Humanitarian projects commonly map the first categories listed here. Points of interest are features that need more local knowledge or resources, such as ground-level imagery to collect. The other categories demand only satellite imagery or aerial photos, which helps their acquisition when on-site activities are limited due to the constraints caused by the pandemic of COVID-19.

In acquiring the geometries of the features in favelas, it is essential to be careful about the topological relationship between them. At the time of vectorization, the volunteers must supply more details, such as bridges or culverts at the intersections between the road system and drainage system elements. Other basic precautions are not to intersect buildings with other elements. In addition, all roads or hydrographs must have the

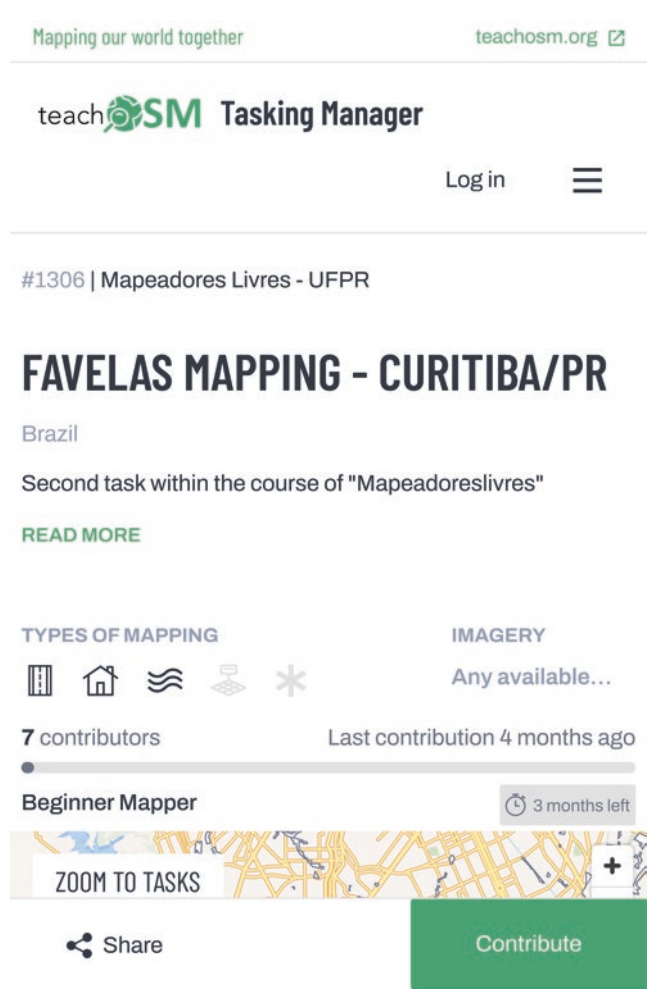

Fig. 6.3 YouthMappers in the UFPR chapter utilize the TeachOSM Tasking manager to map in favelas

direction of flow and be intra-connected to be used in network analysis or routing. Mapping that pays attention to topological relationships allows using that favela database in products beyond a static map.

Finally, when vectorizing features with good practices in mind, we should not focus only on the geometry but also categorization and attribute completion. For example, roads in favelas can have distinct characteristics from others in the formal city, making it essential to define the correct category or fill attributes according to their trafficability. The mapper needs to consider the type of surface, the width of the road, and the existence of sidewalks, stairs, or bridges, as in some cases for vector geometry, filling in the category and attributes may require local knowledge or ground-level imagery for a more accurate feature description.

4.2 Open Tools and Best Practices

The tools used are linked to the OpenStreetMap ecosystem and include some editors of its database. iD is the web editor with the most extensive user base and has a more accessible interface and more simplified functionality. In contrast, JOSM is a completer and more complex desktop editor, which allows for more functions, but with a higher learning curve. Therefore, the choice of the tool must be made according to the experience and interests of the audience. We rely on the TeachOSM platform, which can help us organize

mapping and validating the census sectors of subnormal settlements (denomination of the Brazilian Institute of Geography and Statistics for favelas) in the metropolitan region of Curitiba.

The good practices of collaborative favela mapping are not unanimous but systematized materials such as courses, video tutorials, or manuals. Thus, it was an interlude between collaborative and humanitarian mapping experiences and the dissemination of new mapping processes for this territory.

5 Accessibility in Brazil

Accessibility is fundamental to guaranteeing human dignity and well-being. The concept of accessibility refers to the entire and universal condition of reach, perception, and understanding of public spaces. This concept gives the idea of use with autonomy and safety of the common spaces. People have unique needs to meet their accessibility. In such a way that people with disabilities (PwD), the elderly, pregnant, obese, and people with reduced mobility are contemplated in the accessibility laws.

The United Nations (UN) addresses accessibility through the Sustainable Development Goals (SDGs) globally. SDG 10 promotes the social inclusion of people with disabilities. SDG 11 encourages the adaptation of cities to be inclusive and accessible. In Brazil, the adaptation of urban equipment with adequate conditions for accessibility still does not meet the necessary demand. As a result, it is possible to see noncompliance with the technical standards regulated by the Brazilian Association of Technical Standards (ABNT) nationally in public spaces.

The Brazilian press has reported the incongruence in urban spaces making access and mobility impossible in cities such as Jundiaí/Sorocaba-São Paulo, Brasília-Distrito Federal, and Porto Alegre-Rio Grande do Sul, showing disrespect for the disabled and for technical standards. A study by Remião (2012) highlighted the lack of accessibility in schools in Viamão-RS and has concluded that the problems met are not something localized but a general problem that the responsible authorities should address based on technical standards. Azevedo (2020) has conducted a study on the access of PwD and older people to transportation in their first and last mile, especially on rainy days in São Paulo and found that it is necessary to apply public policies to improve and guarantee equality and the right to urban mobility without having to face obstacles in the access to and between urban cities. The precarious situation and the disregard toward the theme can be due to ableism present in Brazilian society. Ableism is a discriminatory practice toward people with disabilities. This practice is based on the social construction of a perfect body and underestimates the ability and aptitude of people due to their disabilities.

Data from the Brazilian Institute of Geography and Statistics (IBGE), from the 2010 census (IBGE, 2010), show that 6.7% of the Brazilian population has some disability although only 330,000 have a signed work card. Prejudice is evident in quite common colloquial expressions. In this scope, the mapping of accessibility conditions aims to contribute to the supply of information to denote such reality. This action supports SDG 10 and 11, especially the latter, impacting two fronts: inspection (A) and access optimization (B).

The inspection of the degree of compliance with accessibility conditions throughout the geographic space can be applied in two main ways: to expose the neglect/disinterest in its implementation (A-I) and to draw up strategic plans to achieve adequacy (A-II), such as the revision of municipal master plans.

About the optimization of the use of space by people with accessibility limitations, there are two main applications: the provision of improved routes avoiding “barely” or “non-accessible” stretches (B-I) and the classification of the accessibility conditions of public facilities and spaces (B-II). In both cases, the aim is to supply proper solutions for the distinct types of limitations/disabilities.

5.1 Contributing Accessibility Data to OSM

For the collaborative mapping activity, in compliance with the SDGs, we suggest the OpenStreetMap (OSM), which has various tools and an active community that develops solutions and contributes with mapped data made available on its platform. It is possible to develop maps on the platform to meet specific needs. Many of these tools are designed for the needs of users with disabilities, highlighting the Wheelmap tool (which infers the degree of accessibility of facilities for wheelchair users, meeting the B-II). Another tool is the OpenRouteService (which meets the B-I, generating optimized routes for wheelchair users). These tools highlight the importance of open data to support accessibility.

In this context, Mapeadores Livre acts by researching, producing content and materials, and conducting training on "how to map accessibility in OpenStreetMap." In addition, the group put this theme on the discussion for their first extension course. The organizers divided the content into three parts: (1) introduction and motivation about accessibility, (2) geometries for the theme, and (3) tags for the theme.

5.2 Contributing Concepts to the OSM Data Model

Part 1 introduced the concepts presented here throughout this text, emphasizing how lack of accessibility is the product of an ableist society. In part 2, we present the importance of mapping sidewalks as separate features from streets and connecting the two using intersections, emphasizing the importance of connectivity of the elements and teaching students about topological relationships between features. Part 3 shows how to characterize the degree of accessibility of the features mapped in part 2. This part introduces the students to OSM's integration with collaborative terrestrial image databases such as Mapillary and KartaView. These services allow detailed visual inspection of features, and the students performed the mapping tasks using Teach OSM's Tasking Manager.

Thus, by addressing this topic, the Mapeadores Livre group aims to expand the cartographic community on such a topic and increase and broaden the availability of such data in OSM, in addition to various thematic activities such as mapathons and courses that are planned in the chapter's future activities.

6 Final Considerations

More than a university activity, Mapeadores Livres connects various social organizations, their humanitarian projects, and the university in its research themes. The projects undertaken within the group aim to expand the mapping community trained in favela mapping and accessibility and increase the availability of data in OSM.

Our group's mission is to continue linking teaching, research, and connection with the community. In teaching, participating in the group helps create more proactive professionals to create and develop their projects in an autonomous and participative way. Furthermore, through the various activities, we can integrate this knowledge into the training of various professionals within the university, both at the undergraduate and postgraduate levels. In terms of research, emerging themes such as data quality, the integration of diverse sources, and the dynamics of contributions in diverse contexts help us propose technological solutions and expand the frontier of cartographic knowledge in these new scenarios. Additionally, the university as part of the community, helping to solve the country's real problems, is the complement both for building citizenry and for the integration so necessary in the construction of a fairer society.

In addition to these relevant internal aspects, being part of a Brazilian network, exchanging experiences with our colleagues from such differ-

ent realities only motivates us to continue expanding the work of the YouthMappers in Brazil and Latin America. Finally, expanding this vision even further, in an interconnected world, being part of an international network, especially one with a significant presence in the global south and a real connection to a humanitarian vision, contributing to the UN SDGs, is a unique experience.

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