MAKING THE INVISIBLE VISIBLE: REVEALING DATA IN THE CITY

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Hacer Visible lo Invisible (Making the Invisible Visible) is a project that observes cyclists' routes in the city and transforms this data into three-dimensional sculptures, which also serve as public bike repair stations. These objects not only enhance the public space and serve as necessary reference points for navigating the city, but also encourage cyclists to observe the movement of bicycles in Quito while fixing their own bike tires. The system consists of (i) a mobile application that records cyclists' circulation throughout the city, (ii) DIY bike counters embedded in public spaces, (iii) bike repair stations as sculptural landmarks, and (iv) a web terminal displaying real-time recreation of the city on a new map. Throughout this intervention, conventional and unconventional tools were employed for data collection (i.e., designed diaries, interviews, surveys, participant trajectory, and observation), and representation (i.e., multicriteria analysis, digital maps, and physical visualizations). This article aims to reflect on the development of a set of interfaces that invite contemplation, imagination, and the construction of a data-driven city based on the specific and collaborative contributions of its inhabitants.

Keywords: Physical visualization, Data sculptures, Data-driven design, Trajectories.

1 INTRODUCTION

At the beginning of the XX century, cities transformed themselves in a radical way due to the boom of dependence on cars for transportation. Spaces initially designed for pedestrian activities and human interaction were occupied by combustion vehicles (Norton 2015). This modified the shape of the cities and also had repercussions in the way that people inhabit them (Debord 1959). Likewise, dominant cultures have imposed a colonial discourse in the representation of cities through maps (e.g., Google Maps). Huggan (1989) mentions the effects of the control of “physical (geographical)” and “conceptual (metaphorical)” maps in the reinforcement of a unique narrative.

As a counterpart, community-based methodologies (Olson et al. 2016) may be considered a starting point to reimagine spaces by engaging in a dialogue with specific groups of inhabitants. From a social practice perspective (Spotswood et al. 2015), communities are shaped by their context. This implies that a combination of symbolic, material, and competence-related elements is necessary to describe their environments. To unpack these elements, this paper will explore the possibilities of different cities within the city through data-driven design (Richardson 2016) to discover the potential in combining diverse inputs and outputs to gather and reveal community data.
2 CONTEXT

HVLI (Hacer Visible lo Invisible; Making the Invisible Visible in English) is a project for data exchange through a set of interfaces. This system gathers data about the behavior of cyclists in the city, then transforms this information into virtual (Stusak 2015) and physical (Jansen 2014) data sculptures. The aims of this exchange are (i) symbolic, to represent the movement of the participants; (ii) aesthetic, to enhance the public space with living sculptures; and (iii) functional, to allow bicycle users to access tools for maintenance.

The first intervention was the FMB8 (Foro Mundial de la Bicicleta 8; World Bike Forum 8 in English), an event that was held in the city of Quito in 2019. In this space, cycle-activists discussed the role of bicycles in urban mobility. For the event, the extended design team identified the needs of a bike repair station for the travelers who would attend, as well as the opportunity to elaborate a landmark that commemorates the presence of the event in the city.

Quito is located at 2850 MASL in the Andes Mountains in Ecuador. Despite the region’s geographical complexity, about 20,000 of all the daily trips are done by bicycle users through the 133 km of official bike lanes. In the last twenty years, some political changes have boosted the urban bicycle movement (Municipio de Quito 2022, Barriga-Abril et al. 2023). In this context, the HVLI sculptures were thought of as a product with symbolic characteristics, since the object would represent the routes taken by cyclists in the city. For this purpose, a diary was designed for the collection of the participants’ journeys. This self-report journal asked the participants to draw and reflect about their mobility in the city for 24 hours. Twelve people completed the task, and a new map of the city was created with the information they had provided.

![Figure 1](image.jpg)

Figure 1. Set of photos showing the process of design and creation of the HVLI sculpture.

The collected data was used as the basis to create different maps of Quito. The drawings represent different segments of the cyclists’ journeys. This information was used to shape the physical sculpture (Figure 1) by selecting the matching routes. Then, a group of designers took the model and made a three-dimensional version also taking into account usability and functionality requirements. Later, the object was tested in FMB8 by the visiting cyclists, and finally, it was installed in PUCE (Pontificia Universidad Católica del Ecuador; Pontifical Catholic University of Ecuador in English) for evaluative purposes.

3 GATHERING AND REVEALING DATA

During the pandemic, Quito underwent a significant transformation in terms of mobility. The number of urban cyclists increased by 650%; likewise, the infrastructure of bike lanes also improved (Quito Cómo Vamos 2020). However, Quito Cómo Vamos Initiative mentions that more accurate data is necessary to typify the cyclist phenomena. Hence, this HVLI project has created a set of interfaces to continue the process of gathering data and revealing this part of the city.
The interfaces are aligned with different conventional and non-conventional methods to collect a wide variety of information at different levels. The following section will describe (i) a multicriteria analysis of the city, (ii) some self-report methods, (iii) the trajectories of selected cyclists, and (iv) the physical HVLI sculptures.

3.1 Multicriteria Analysis

A multicriteria analysis was used to determine the adequate location for three HVLI sculptures. Possible locations were prioritized accordingly employing land-use and transportation planning concepts mainly in relation to: (i) the existing cycling infrastructure (i.e., bicycle lanes, public bicycle stations); (ii) public transport stations open to integration of cycling, primarily the future subway system; (iii) the urban fabric (i.e., public space, urban equipment, public services, housing), and (iv) functions such as higher education centers. This first phase of location parameters would later be adjusted by: (v) tentative sponsors, guardians of the HVLI sculptures; (vi) unveiled cycling hotspots, revealed by the data collection; and by (vii) new urban mobility policies.

Maps (Figure 2) were built using QGIS to process publicly available shapefiles from the local government land-use planning department. The conceptualization behind these maps was supported by the synthesis of the urban features into paths, nodes, edges, districts, and landmarks (Lynch 1964). These elements shape the individuals’ spatial cognition of the city and its movements: “urban cycling seen through the HVLI sculptures”.

![Figure 2. Location analysis map of HVLI Sculptures.](image-url)

Based on the analysis, the design team determined that the first three HVLI sculptures would be placed in La Magdalena, El Ejido, and Bicentenario Park due to their strategic location for the development of the cycle infrastructure and the well-being of the community.

3.2 Cyclist Communities

Different methods were applied by a team of PUCE product designers and their students as part of their course. They explored the communities of cyclists through the use of interviews and surveys to describe behaviors, needs, and community problems.

An important finding from the research is that in Quito, urban cyclists face constraints due to inadequate urban infrastructure. In fact, 58% of respondents expressed dissatisfaction with locating bicycle parking spaces. This lack of infrastructure contributes significantly to a sense of insecurity, as confirmed by 90% of those surveyed. Furthermore, the name of some common routes surfaced in the research, such as Amazonas Avenue, 6 de Diciembre Avenue, and Bicentenario Park. These routes, located in the north central part of the city, were also reported as some of the most used
routes by urban cyclists in the Master Plan of Mobility 2022 - 2024 (Municipio de Quito 2022). The data suggested that a prevalent discontentment exists within the cycling community regarding the urban environment. Cyclists frequently find obstacles and deal with unfavorable encounters in their daily activities, due to various elements of urban mobility such as pedestrians, vehicles, public transportation, routes, and road infrastructure. These challenges demonstrate a deficiency in road culture and often reflect a lack of empathy towards cyclists in the urban setting.

3.3 Trajectories

After the experience of the first approach, the authors worked on a methodology to describe the map based on the cyclists’ everyday routes. The diary was an important resource; however, for a more accurate assessment, it was necessary to develop a digital tool.

For the second approach, an app prototype was coded in Processing to create drawings based on the journeys the cyclists took. The system collects information through GPS and uses a graphic library to draw an individualized map while the participant moves across the city. The app was tested for a year with a participant trajectory register (Benford and Gianacchi 2008). The outcome was a set of individual routes and a complete version of each participant’s personal map.

![Figure 3. Set of picture and route of the three participant trajectories.](image)

Subsequently, a new register was designed to represent the routes of three different participants (Figure 3) and to correlate the locations determined by the multicriteria analysis and the shape of the new HVLI sculptures. Three participants, who regularly move in the chosen areas (i.e., La Magdalena, El Ejido, and Bicentenario Park), were recruited to, along with the team, draw their movements while traveling across the city. The graphics of their routes vary in terms of distances and shapes. This in particular creates an interesting problem to solve in the sculpture design process due to the unique physical visualization that emerged from each one.

3.4 HVLI Sculptures

The HVLI sculpture is one of the products of the methods that have been applied. As it was mentioned, this object seeks to combine functional, symbolic and aesthetic dimensions based on the data provided by the research.

Thus, the bike repair station was updated through monitoring the use of the first implemented station, as well as synthesizing the information provided by the cyclist community. A new structure for the bike tools was designed (Figure 4). Parking spaces were also included in the station and a more representative system was implemented to divulge the project and to prioritize the visualization of the routes.
Each station represents a particular part of the city. The results of the multi criteria analysis suggested the opportunity to implement a HVLI sculpture in *La Magdalena, El Ejido,* and *Bicentenario Park* to enhance the cycle infrastructure. The shape of the stations is directly related to the trajectories of the chosen cyclists. Additionally, a sign was included with information briefly explaining the project and offering access to a collaborative map on the web, still in progress, where users can expand the content. As it is, these sculptures attempt to reinforce the characteristics of (i) user-generated content in public art (Krumm *et al.* 2008) by changing the shape of the structure in each part of the city, mapping the movement of a randomly chosen participant; as well as (ii) the physical visualizations of data sculptures (Jansen 2014) to explore different ways to engage the community with the veering shapes of the city.

4 CONCLUSION

In this study, the authors focus on understanding, describing, and representing the characteristics of the cyclist community in Quito, particularly unveiling various versions of Quito's maps that were previously invisible. This introduces a novel perspective on city representations, emphasizing the importance of considering non-dominant cultures to unearth both the "physical (geographical)" and "conceptual (metaphorical)" dimensions of their narratives. Furthermore, the project contributes to the understanding of cycling as a fully-fledged mode of transport, shedding light on a fragment of the social practice that strengthens elements of urban cycling.

The HVLI methodology serves as a reference for exploring diverse methods to gather and reveal cycling data. Its notable strength lies in the synergy between community-based and data-driven design methods. This synergy delves into the application of conventional tools for understanding and describing, and, more importantly, the development of unconventional tools for data collection and representation. This aspect is crucial not only for understanding different geographies but also for creating a variety of data-based artistic products. While exploring these data representations, questions arise, particularly regarding biases rooted in dominant cultures (Vanian 2018). Despite adopting heuristics (Szafir 2018, Davis *et al.* 2021) in this project's development, it is essential to underscore that the goal of these representations should not be to create an absolute reality but rather a version of it.

Finally, cities must adopt decolonizing perspectives to envision spaces inclusive of invisible communities. This methodology proposes: (i) co-creating symbols of the community to encourage participation; (ii) employing aesthetics for crafting artwork with a data-driven approach; (iii) integrating functional infrastructure to cultivate welcoming spaces in the city. Looking ahead, the information collected should aim to serve as a source of real-time data to shape public policies.
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References


