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Towards a more Liveable and Accessible Cycle Path Network in Padova: a Participatory Mapping Process

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1 ABSTRACT

With the advent of climate-related issues and low-carbon economy, networks of cycle paths and tracks are becoming a more and more relevant mobility infrastructure for cities. However, mapping their critical points in order to fix them to improve liveability and accessibility can be difficult. One solution may be to combine digital technologies and users' knowledge, using the methods of participatory mapping.

The first experiences in participatory GIS, in which geo-information technologies are used in support of collection, creation and sharing of spatial information by non-skilled social actors, date back to the nineteen-eighties. This bottom-up approach saw a strong evolution in recent years, even in the European urban context, thanks to the constant development of digital technologies and to the increasing opportunities for citizens to access the web. Free and open geographic data, by means of Public Participatory GIS (PPGIS) and Volunteered Geographic Information (VGI), facilitate the citizens' involvement and participation in urban planning and management.

This is the framework behind PISTE riCICLABILI, an innovative project by the University of Padova started in autumn 2016 and aiming at the following goals: a participatory mapping of critical issues of the urban cycle path network and the implementation of an open source geo-portal for collecting and sharing geo-referenced reports.

Within the workflow developed for this project, spatial information has been collected in two different ways: on the one hand, using printed city maps during public events, where involved citizens marked the cycle paths issues with pins; on the other hand, through a mobile geo-app.

In the second case, Open Data Kit (ODK) was used. It is a combination of free and open source tools enabling everyone to create a form to be filled in with a smartphone in the field, and to send geo-referenced reports to a server. Mobile data were collected using the GeoODK Collect Android app, then aggregated and periodically exported, reprocessed and released through the open source webGIS platform Lizmap.

First results of the process, which experienced a growing participation by citizens, consist of over 300 collected critical points. Through the analysis of these data it is possible to have a first overview on the main problems of bicycle mobility in Padova, their spatial implications and citizens' suggestions to improve human-oriented places.

This contribution presents the mapping and data spreading workflow, together with results achieved and possible future development, with the aim to share a promising tool to improve urban sustainable mobility.

Keywords: open source, cycle mobility, volunteered geographic information, public participatory GIS, georeferencing

2 INTRODUCTION

In many European cities, different "bottom-up" projects are being experimented with the involvement of students and citizens, enabling them to create and share geographical information, with a view to increase their participation in sustainable urban planning and management.

The first experiences of participatory GIS (Public Geographic Information System, PGIS) date back to the 1980s in the developing countries, where the population is involved and supports the production, use, share and communication of spatial information and knowledge (Rambaldi et al., 2006). This PGIS approach is

taking place since the second half of the 1990s also in developed countries, with the spread of several approaches, techniques, and methodologies that can fall under the definitions of Public Participatory GIS (PPGIS) and Volunteered Geographic Information (VGI) (Brown, Kytta, 2014). This process is made possible by the diffusion and increasing availability of technologies (smartphones with GPS, internet and web-mapping) and open source and low-cost spatial data (such as OpenStreetMap). In the PPGIS, public decision-makers try to involve stakeholders in a given decision-making process concerning a territory, like in urban management plans or natural park management plans (Brown, 2012; Sieber, 2006), while the VGIis characterised by its voluntary nature has become known more recently than others through diffusion. In this case it is the individual citizen who more or less voluntarily decides to produce new geographical information within areas not strictly related to decision-making processes: for example daily activities (traffic information, cycle paths, etc.) or social activities, such as environmental monitoring and mapping of places of interest (Capineri et al., 2016).

Both in the scientific literature and in the mass media a growing interest can be noticed in the dissemination of projects for the production of participatory spatial information, with the use of different tools (printed maps, web-mapping, smartphone apps, etc.) and methodologies (participatory mapping during focus groups, crowd mapping, etc.); such spatial data can be analysed with the use of GIS software in several ways, producing output such as maps and statistics useful for the most diverse aims, and can be eventually disseminated and shared via WebGIS, on a blog, or inserted in a paper report (Brown, 2004; Brown, Kytta, 2014; Pacino, 2017).

This is the framework behind the project called "PISTE riCICLABILI", a participatory mapping project created in 2016 and still underway, funded by the University of Padova and led by the Department of Civil, Environmental and Architectural Engineering (ICEA), with the collaboration of the professional master in "GIScience and Unmanned System for the integrated management of territory and natural resources". The project aims at the following goals: participatory mapping of critical issues and attributes of the urban cycle path network of the city of Padova and implementation of an open source geo-portal for collecting and sharing geo-referenced reports.

The participatory collection of spatial data and their spatial analysis can be a valid support to the management of mobility, especially for a city like Padova that is top in Italy for number of bike trips (Padova24ore, 2017). Moreover, with the advent of climate-related issues and low-carbon economy, networks of cycle paths and tracks are becoming an increasingly relevant mobility infrastructure for cities. This analysis could become the first basis for prioritising critical parts in the cycle path system and where to identify the most suitable actions in order to solve the highlighted problems. At the same time, it could help make the public decision-making process more effective and incisive regarding the improvement of the existing and planned network of cycle paths. In particular, the project aims to involve the university students who, despite being the main bicycle users in th city of Padova, are often stakeholders with no voice in the decision-making processes related to mobility.

3 MATERIALS AND METHODS

In the project “PISTE riCICLABILI”, the ability to include different actors in the mapping process is considered as one of the key factors in the choice of methods and tools to utilise. Considering that the subject matter is of great interest and is addressed to all citizens of Padova without distinction of category, it was necessary to adopt two different mapping methodologies to reach the maximum possible participation: a) paper mapping assisted by trained persons, and b) voluntary mapping via smartphone app and web. The two methods are in many aspects complementary, allowing to reach different segments of the population. The critical issues or attributes mapped were selected and validated with the support of local environmental associations (the list of attributes used is shown in figure 1 at the top right corner).

The paper mapping work assisted by trained persons was carried out both during some organised public events (such as sustainability festivals organised by the municipality or university festivals), and intercepting important flows of people in strategic points (e.g. near university canteens). Citizens were asked to apply place marks on the city map showing the municipal cycle path network. The place marks were categorised with colours, each of which corresponded to certain types of issues or attributes (in figure 1 in the lower right corner is an example of paper mapping work during a festival).

Attributes mapped

Mobile obstacle on the cycle path

Fixed obstacle on/close to the cycle path

Discontinued cycle path

Dismal cycle path

Dangerous cycle path

Missing cycle path

Missing or not enough bike racks

Lack of adequate indications

A bike sharing station would be needed

It would be needed the possibility to go in the wrong direction

Good or ideal cycle path

Fig. 1: The list of the attributes to be mapped (on the left). An example of paper mapping work during a festival (on the right).

The voluntary mapping work via smartphone app and web took place through an app for Android devices (GeoODK Collect) that allows users to report critical issues directly on the road with the use of their GPS or by posting a form on their smartphone, associating its position (in figure 1 at the top some screenshots of GeoODK Collect interface). For actors (compilers) without a suitable device or who prefer to use their PC, an online form has been made available through the jotform platform (https://form.jotform.co/, in fig. 1 in the lower left corner a screenshot of jotform interface). All compilers were asked, on a voluntary basis, to fill in a profiling form, in order to be able to cross the information regarding individual habits, with the type and distribution of points mapped.

Fig. 2: A screenshot of the jotform interface.

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Fig. 3: Some screenshots of the GeoODK Collect interface.

Regarding the mapping via smartphone app, besides choosing one or more of the 11 available categories and associating the position, through the GeoODK Collect app a user can add a number of additional information, including photos, comments and the level of discomfort perceived in a scale from 1 to 5 (see Figure 1). The whole process is based on Open Data Kit (ODK), a set of free and open source tools that enable anyone to create fillable forms on Android devices and to collect reports in a server (https://opendatakit.org/). In this case, ODK Build was used to create the forms, ODK Aggregate for the management of the forms on the server and GeoODK Collect to perform the mapping work via smartphone. ODK Aggregate is the central element of this process: it permits to manage the database, user permissions, form settings, aggregation of collected data and their exportation in different formats (CSV, KML, JSON). All collected data are periodically exported in CSV format and reprocessed with QGIS software to obtain a spatial representation of the critical issues reported and to perform spatial analysis.

The last stage of this participatory mapping process is the re-sharing of the collected data. Since this is a project that makes use of substantially free tools, it was decided to use the QGIS plugin Lizmap for the publication of the results in a WebGIS, producing an interactive map which can be enquired and printed.

4 RESULTS AND DISCUSSION

During the processes of paper mapping and voluntary mapping via smartphone app and via web carried out in 2016 and 2017 (data updated in November 2017) a total of 616 points were collected (798 reports considering the points with multiple attributes). They were divided into 11 attributes, as shown in table 1, while the spatial distribution of all points mapped is shown in figure 3. In the 2016 collection campaign, the categories chosen during the planning phase had been reduced in order to simplify the collection made through paper mapping.

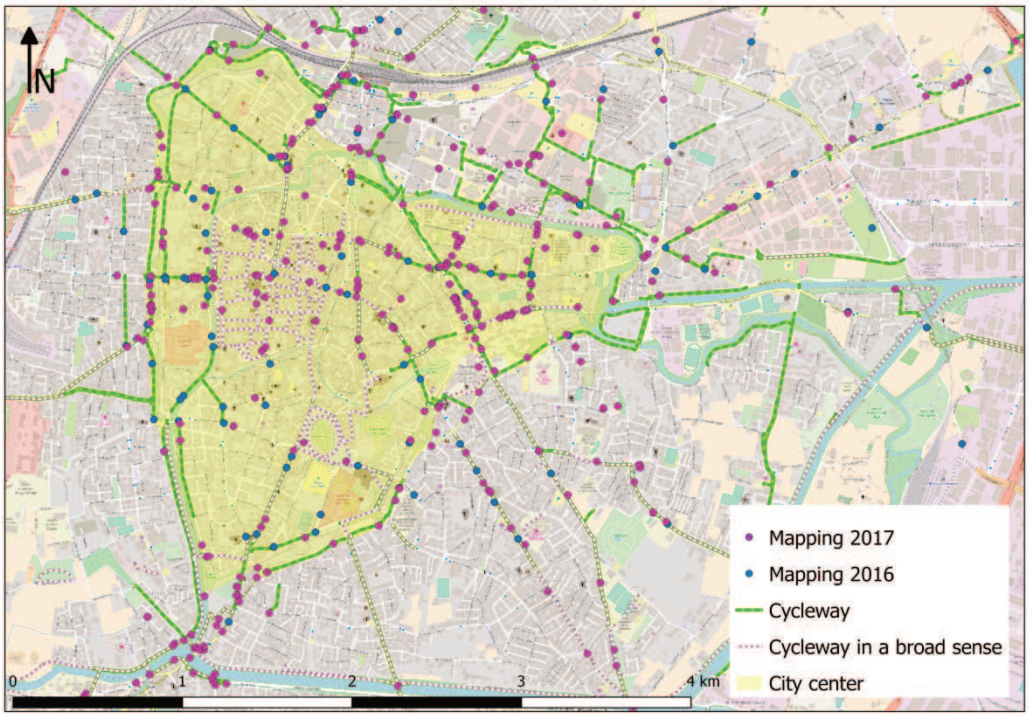

Fig. 4: Spatial distribution of all points mapped in 2016 and 2017

Thanks to the subsequent implementation of the mapping in digital format via app and via the web it was possible to map the entire range of attributes selected, as shown in table 1, also including a positive attribute, that is "good or ideal cycle path".

Attributes	Points mapped 2017	Points mapped 2016
Mobile obstacle on the cycle path	71	50
Fixed obstacle on/close to the cycle path	57	
Discontinued cycle path	63	
Dismal cycle path	71	15
Dangerous cycle path	138	20
Missing cycle path	125	31
Missing or not enough bike racks	41	
Lack of adequate indications	35	
A bike sharing station would be needed	19	
It would be needed the possibility to go in the wrong direction	47	
Good or ideal cycle path	15	
Total	682	116

Table 1: Number of points divided by attribute categories collected during 2016 and 2017.

Regarding the points marked via app and via web carried out till November 2017, figure 2 shows the corresponding attributes divided into reports within the historical centre and those outside the historical city walls. Most points fall outside the historical centre but two categories are more represented inside it, that is “possibility to go in the wrong direction” and “mobile obstacle”. These are indeed two very common problems because of the high density of narrow one-way streets in the centre and the parked cars on or close to a cycle path. The reports regarding bike sharing stations need is almost completely localised outside the centre, meaning that this service is well distributed in the centre but needs an expansion to some peripheral zones (like Forcellini, Guizza and Arcella quarters). In addition, the main south access road to the city (Guizza-3 ponti zone in yellow in figure 2) has been reported many times with critical issues concerning various aspects, so it could represent a “hot point” for planning interventions by the municipal administration.

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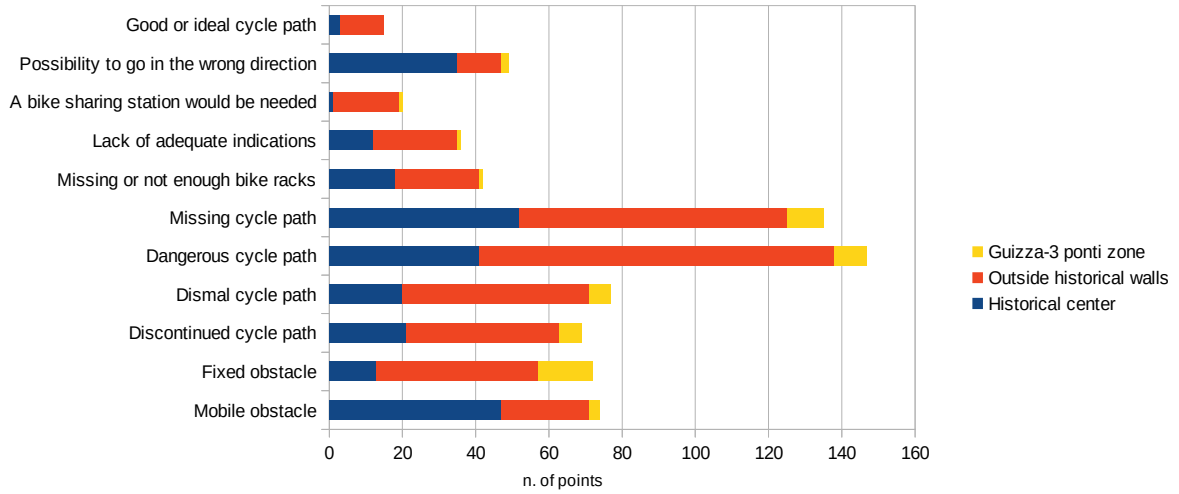

Fig. 5: Distribution of the mapped points (in x-axis the number of points, in y-axis the different attribute categories) inside (blue) or outside (red) of the historical centre of Padova, collected during 2017. In yellow are indicated the points marked along the south access to the city.

All the points related to the different types of critical issues collected till November 2017 have been analysed in GIS environment. A first product concerns density maps related to the concentration of the different mapped attributes, a simple form of analysis that is able to give an initial indication of the areas to be prioritised in support of interventions be the municipal administration An example is shown in figure 4. It highlights in lighter to darker shades of red the main sections of roads where citizens have reported the attribute "the possibility to go in the wrong direction would need to be included". Other density maps have shown that the major obstacles reported relate to the railway station, access to the south of the city and in the confluence section of the car and bicycle traffic coming from the west.

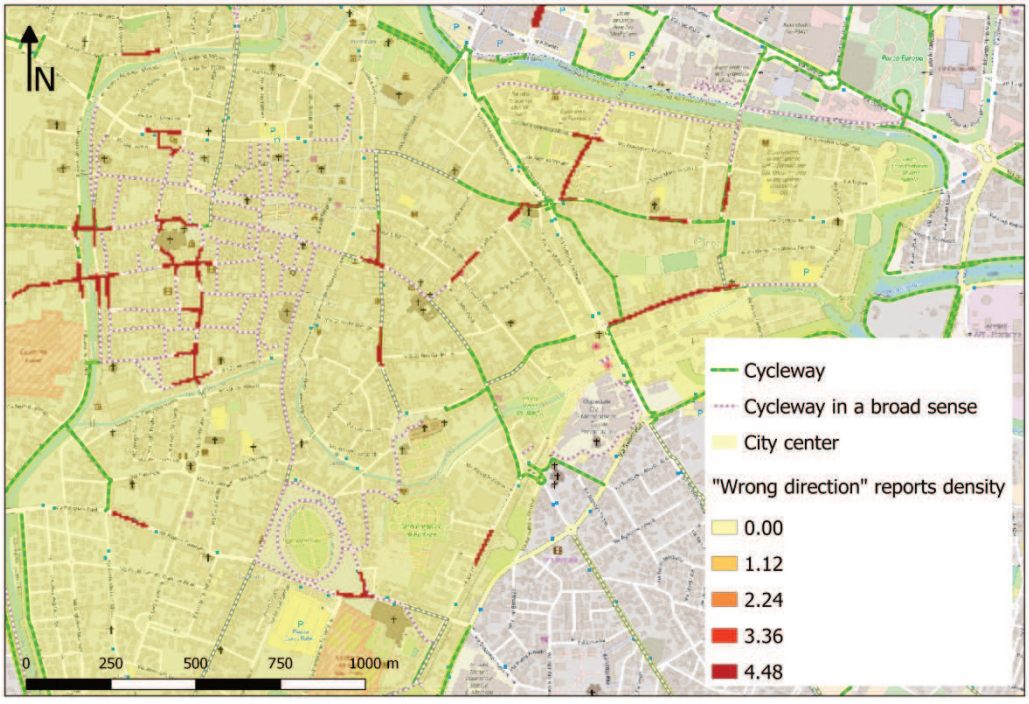

Fig. 6: Density map of points related to the attribute “It would be needed the possibility to go in the wrong direction”.

In addition to the mapping work, an important component of the project has been the dissemination of results, through the website and articles in the local press, but especially during public events and presentations, where the space left to debate made it possible to enrich the spatial information mapped. For example, on several occasions, the distribution of parking spaces for bike sharing in Padova has been mentioned: it is concentrated within the historical city walls, while there have been different requests for obtaining new bike parking spots, together with the need for new bike racks outside the walls, in the inner

peripheral zones. Another key aspect, revealed also by several descriptions linked to the points marked, is that the bike path is well divided by the road network.

All the information produced, the WebGIS and these results can be freely consulted on the website of the project created ad hoc and periodically updated (https://pistericiclabilipd.wordpress.com).

5 CONCLUSION

In conclusion the project has showed a good participation by students and citizens and the data collected allowed the creation of a precious database. Over 600 georeferenced reports represent a good base to perform spatial analysis with the aim to localize the priority intervention areas. On this point, also the public administration have showed an interest to undertake a collaboration. Indeed, there have been several moments of collaboration with the municipality, and in particular with the bicycle office, for the promotion of the project. The whole data collected have been shared with the contributors, the institutions and any other interested party through a webgis based on the Lizmap platform, available from the project webpage.

Together with these results, this first year of project brought out some fundamental questions from both a conceptual and a methodological point of view.

A first methodological question concerns the effectiveness of the use of paper maps during particular events or the use of smartphone apps and/or web-mapping. If, on the one hand, the paper map has proved more effective from the point of view of participation and collection of points, it limits the number of mappable attributes and is definitely time-consuming, especially the process of digitization and georeferencing.

Special attention should be given to the question of which actors take part in the participatory process and thus the analysis and evaluation of the results obtained, since the information collected may be biased by the exclusion of some stakeholders in favour of others, or by a lack of representation of the population involved in the process. When planning a participatory process, using statistical tools to choose the sample or including stakeholders in a focus group one must avoid the phenomenon of participation inequality: that is when a small percentage of participants contributes to a significant portion of information production compared to the total involved (Haklay, 2016; Brown, Kytta, 2014). Finally, to assess the quality and effectiveness of the participatory process in decision making cases, Beierle (1999) indicates some guidelines to be taken into consideration: whether the process has educated and informed the public, included public values, increased confidence in institutions, reduced conflict and improved decision-making quality (Brown, 2012).

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