Beyond social networks contents: how Social Media Geographic Information may support spatial planning analysis

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Introduction

Since the last 20 years, Information and Communication Technologies (ICTs), the Internet, and more recently the Web 2.0 platforms have fostered the entry of novel technologies into people's daily life. Current innovations are easing the production, the sharing and the access of multimedia contents that are autonomously generated and consumed by millions of users worldwide through web platforms or social networks sites, namely User-Generated Contents (UGCs) (Krumm et al. 2008). The wealth of UGCs, daily disseminated through the Internet, is potentially transforming the Web in a novel source of digital Geographic Information (GI) (Elwood et al. 2012), inasmuch most of the shared contents embed a spatial reference, thanks to the availability of global positioning system (GPS) and sensors in handheld devices, as well as, because of the advanced functionalities for georeferencing offered by geo-browsers or location-based social networks, utilized during contents' production.

This phenomenon is enabling the forecasted convergence of social media and GIS (Sui and Goodchild 2011), facilitating interactions and the building up of constructive dialogues regarding places and social issues among users. Indeed, the broadening of the GI collection, use and diffusion, from a small group of experts to potentially the whole community, may trigger major changes to maps production and consumption (Engler et al. 2014), leading toward new scenarios of cartographic interactivity (Roth 2013) and, eventually, guiding the renaissance of GI (Hudson-Smith and Crooks 2008). At the same time, the contemporary ICTs diffusion and GI availability may foster noteworthy innovations in spatial planning methodologies and practices, potentially allowing new modes of working, communicating and participating.

Commonly, georeferenced UGCs are referred to as Volunteered Geographic Information (VGI), stressing the voluntary role hired by users for freely collecting and contributing GI related to the geographic world in a bottom-up approach (Goodchild 2007). Particularly, a VGI subset called Social Media Geographic Information (SMGI) (Campagna 2014), namely GI implicitly and/or explicitly produced and shared through social network sites, may disclose notable opportunities for spatial planning analysis, allowing not only the collection of quantitative GI but also the extraction of qualitative data regarding users' perceptions on phenomena in space and time. However, the opportunities for using SMGI in spatial planning methodologies have to deal with major challenges related to data accessibility, management, quality and analysis. In fact, SMGI owns Big Data nature because of huge data volume, fast cycles of production and consumption, as well as, heterogeneous, unstructured and often noisy data streams, and, unfortunately, the traditional spatial analysis methods and techniques may be not fully suitable to address these hurdles to

fully exploit this information in practices. Despite in literature an increasing number of approaches is proposed, the access to SMGI by the public is still rather limited (Lazer et al. 2009) and common methods and tools to take advantage of this information still lack.

In the light of these considerations, the paper investigates the SMGI data model, assessing its inherent differences from traditional vector datasets and focusing on the additional featured dimensions. Afterwards, a number of analytical options, which may be accessible to planners and practitioners to enrich the spatial planning knowledge basis through SMGI, are discussed. In this regard, several examples are provided with reference to a number of case studies carried out by the authors, wherein SMGI is proficiently used to support urban and regional planning analysis. Finally, a critical discussion is drawn from the results, arguing the potential relevance of SMGI for supporting spatial planning and identifying future research agenda.

Methodology

The wealth of SMGI, offering insights on users' concerns and freely accessible through the Internet by social media Application Programming Interfaces (APIs), may disclose opportunities to monitor opinions and perceptions of users about experienced phenomena, as well as, their movements and behaviours in urban environments. However, major issues may limit these opportunities, such as the lack of user-friendly tools to collect and to manage huge unstructured datasets and the particular data model of SMGI, which may be barely processed through standard methods without a loss of information.
While the former issue is starting to be addressed by new tools emerging to deal with Big Data, the latter issue may need the formalization of novel analytics methods in order to fully exploit the contents embedded in the different dimensions of SMGI. As a matter of fact, SMGI is inherently different from usual vector spatial datasets, which contain exclusively spatial and thematic attributes. SMGI data model features spatial, temporal, user and multimedia dimensions, thus extending the range of analytical opportunities. In addition, in certain cases, SMGI supplies a preference dimension too, namely the social networks community's appreciation about a topic, expressed through scores, stars or likes/dislikes, thus further expanding the analysis options (Campagna et al. 2015). Moreover, any web platform used to create and disseminate SMGI may present specific features regarding contents' production and sharing, causing issues in integrating and analysing information collected from different sources. Particularly, the multimedia dimension (i.e. text, picture, audio, video) makes it difficult to properly investigate this information by means of traditional query languages, exclusively. In order to better explain the particular nature of SMGI, Figure 1 shows the graphical representation of a general SMGI data model, identifying the available analytical dimensions and exposing the differences from traditional vector datasets.

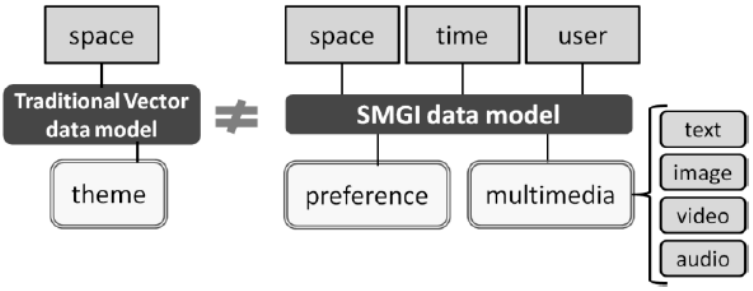

Fig. 1. SMGI data model (adapted from Campagna 2014).

From an analytical perspective, any framework should include not only common spatial analysis methods, but also new tightly integrated methods in order to deal with temporal, user and multimedia dimensions. In this regard, the authors propose a framework to fully exploit SMGI, namely SMGI Analytics, for enriching the knowledge basis about the local context and for supporting spatial planning practices. Operatively, the framework consists of several analytic methods, which may be used in different scenarios for investigating spatial and temporal patterns, as well as users' behaviors, movements and preferences. In the next section, the methods are briefly described with reference to results obtained from several case studies conducted by the authors using SMGI collected from different social media platforms. Despite the differences in the studies' purposes, the first step, required to conduct investigations on SMGI, is always data collection, which is carried out by querying social networks APIs by means of natural language, temporal, spatial and/or user queries. With regards to the case studies presented in

this paper, SMGI data are collected from Instagram, Foursquare, Booking.com and TripAdvisor through spatial and temporal queries, exploiting the functionalities of ad-hoc tools, developed by the authors, to access, extract and manage this kind of data directly in GIS environment.

Results and discussion

The SMGI Analytics framework consists of several methods, which may be used to elicit knowledge useful for different planning scenarios, such as:

- Spatial analysis of users' interests. SMGI may be used to investigate the patterns of users' interest in space by density and/or clustering functions. Overlying official information and SMGI may offer hints to public authorities to understand which places attract the major interest and how they are perceived by users. An example is shown in Figure 2A, where Instagram SMGI is used to detect clusters of highly visited areas in the Poetto Beach of Cagliari municipality, meanwhile Foursquare SMGI is used to identify the venues potentially causing the attraction phenomenon within the identified clusters (Floris et al. forthcoming).
- Spatial statistics on users' preferences. SMGI collected by spatial units may enable the spatial statistic analysis of users' preference. An example is given in Figure 2B, where the hot-spot analysis is applied at the regional scale in Sardinia (Italy) on SMGI collected from Booking.com and TripAdvisor social platforms, to quantitatively study the distribution by municipality of positive users' assessments and to investigate the reasons behind users' preferences for certain specific destinations or areas (Floris and Campagna 2014).
- Multimedia contents analysis. SMGI multimedia contents might be analysed to extract further useful insights. However, albeit currently available texts analytics may enable the investigation of natural language texts, the extraction of knowledge from other multimedia contents is more difficult thus far.
- Temporal analysis of users' patterns. SMGI may allow studying when specific destinations, neighbourhoods, public spaces, or other services are used during different time periods. An example is shown in Figure 3, where Instagram SMGI, related to a public space in the Cagliari municipality, namely the Regional Park of Molentargius and the Poetto Beach, is examined to identify users' utilization patterns of these areas during different periods (Massa 2016). The temporal patterns of weekdays and weekends show notable similarities, while patterns of monthly distribution expose evident differences between summer and winter.
- Users' behavioural analysis. SMGI may enable the investigation of users' behaviours in space and time. Moreover, the user dimension might be used to segment local community's contributors in groups according to common demographic characteristics, preferences and habits, leading toward the potential application of user profiling into spatial planning methodologies (Massa, ibidem).
- Combination of several analytical methods. A combination of SMGI Analytics methods may foster to gain further insights about what people discuss and perceive, as well as, how they interact, move and behave both in space and time, allowing in detail investigation of urban environments and local communities (Campagna et al. ibidem).

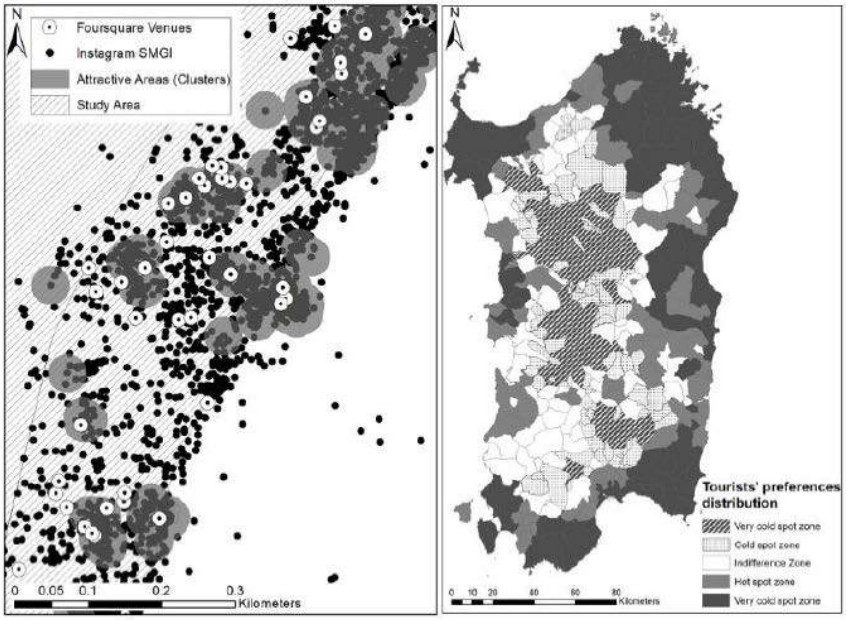

Fig. 2.A. Spatial analysis of users' interests at the local scale. B. Spatial statistics on users' preferences at the regional scale SMGI data model (adapted from Campagna 2014).

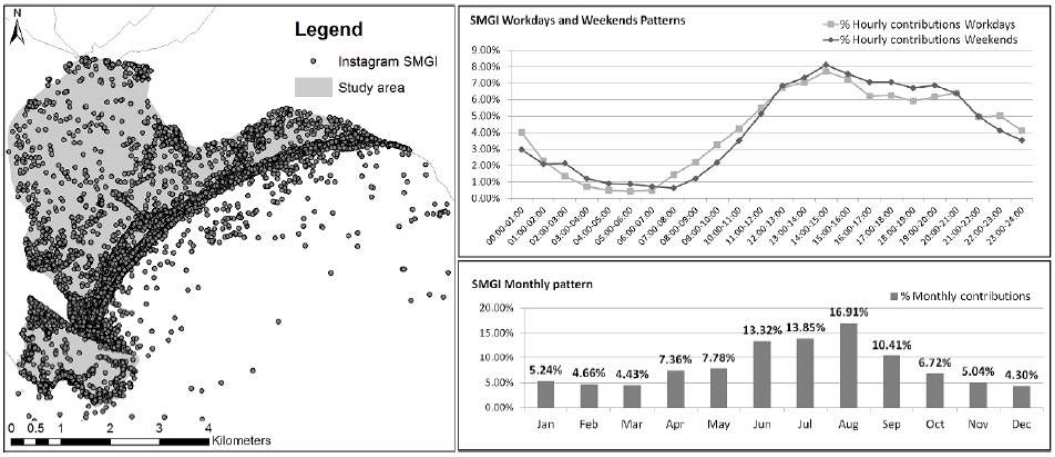

Fig. 2. Temporal analysis of users' patterns

The aforementioned SMGI Analytics methods, as well as the provided results provide a picture demonstrating how this type of information might be proficiently used in spatial planning domain to enrich the available knowledge basis with further information usually excluded from practices. As a matter of fact, SMGI might be used to elicit information, not only about the physical geography of places, but, overall, to gain insights about the perceptions, the concerns and the habits in space and time by the involved community, adding a multifaceted perspective for spatial planning and decision-making.

Conclusions

The contribution discusses the increased availability of SMGI over the global Internet and the opportunities that this type of information may provide to support spatial planning analysis. Currently, the wealth of information enclosed in SMGI may be used to investigate both quantitatively and qualitatively urban environments and local community preferences and habits, greatly extending the range of analytic options.
Nevertheless, in spite of notable opportunities for analysis, it is necessary to be aware that SMGI should not be considered representative of the whole local community. As a matter of fact, social networks are differently used by diverse population groups, which may strongly affect the phenomena under observation with their preferences and cultural biases. Social networks' growth trends suggest that in the future a wider diffusion of these services might occur across all population groups; however, at the time being, different analytical approaches, built upon several platforms, might be required to investigate local context and users' dynamics, appropriately. Furthermore, a number of issues should be further investigated and better understood including the issue of privacy and reliability of shared information. However, early results may be considered very promising and may open alleys for future research streams oriented at fully exploit the SMGI potential in spatial planning practices.

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