Community Mapping for Participatory Decision-Making Processes*

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Abstract. Community mapping is being increasingly used to support crowdsourcing in participatory decision-making processes but the collection of feedback is usually carried out in textual form. We describe a proposal for the management of 3D Community Maps which provide a virtual representation of the territory and enable users to contribute to policy making by sharing different types of contributions, such as comments, documents and 3D models. The paper discusses user requirements and personalization aspects in this type of application.

Keywords: Participatory GIS, 3D User Interfaces, Community Maps, Citizen-centered service design and modeling.

1 Introduction

Various crowdsourcing platforms support the management of participatory decision-making processes by enabling the population to provide feedback and proposals about public policies. For this purpose, most of them enable the collection of textual feedback using standard bi-dimensional maps; e.g., see CrowdMap (https://crowdmap.com/). In a few projects a virtual representation of the territory is offered to enable the visualization of possible scenarios and anticipated effects of the planned actions but the virtual environments cannot be modified by their visitors.

Enabling graphical feedback is important to enrich the communication capabilities within a discussion group as well as to extend the kind of contributions which can be provided by people. For instance, consider the design of a cycling path in a town: several revision proposals (e.g., to correct dangerous curves) could be easily represented by means of a sketch in the town map, possibly enriched with textual explanations of

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the reasons for proposing the changes. However, in order to do that, intuitive tools are needed which can be used by heterogeneous users; e.g., domain experts vs. generic users, or people with different levels of familiarity with computer science.

As a first step in this direction, we developed GroupCollaborate2, a prototype participatory GIS which enables the on-line sharing and editing of geo-localized documents and 3D models in public and private focus groups. The system enables users to share content and collaboratively edit it, as well as to discuss in order to collectively design proposals for the re-development of a territory.

GroupCollaborate2 does not currently offer advanced adaptation features but it enables users to access a personal view of the shared information space by offering customizable filters on the data items to be presented. In this way, it enables people to focus on the portions of the information space they deem to be relevant.

In the rest of this paper Section 2 introduces participatory processes and Participatory GIS. Section 3 discusses user requirements and Section 4 presents our work. Sections 5 and 6 position it in the related research and close the paper.

2 Background

The consolidated practices developed at a national or European level in the participation field are communication, animation, consultation and empowerment [1]:

- Communication is an information activity about public choices.
- Animation has two goals: (i) informing a large social context about the state of the art of a decision process or about the implementation of a program; (ii) favoring the birth of virtuous behaviors among citizens.
- Consultation involves the community in territorial transformation processes for requirement elicitation purposes.
- Empowerment can be interpreted as the enhancement of individual/group abilities. It represents the citizens participation by promoting the auto-organization abilities of people in the social, economic, cultural and territorial fields of action.

Participatory processes are related to empowerment: they are based on a bottom-up decision-making model which promotes the contribution of the population (involving representatives of stakeholders) to public policy development by expressing needs, proposals and feedback with the aim of raising the Public Administration's awareness of the priorities to be addressed and of reaching consensus on the actions to be carried out.

One of the challenges to be addressed in processes related to territorial policies is how to represent space and its inherent relations in a way that is both informative and involving for lay people. As most urban studies data are found in map forms, visualization capacity (by employing mapping services) and the capacity to describe and represent values that people attach to places [2] are critical. Participatory GIS, which support various forms of community participation, are thus emerging as promising tools to overcome traditional barriers to public involvement in decision making processes and policy making with a spatial dimension [3, 4].

Participatory GIS also offer great opportunities to enhance traditional forms of community planning, such as Community Maps drawing. This is a way to represent people's

view of a certain area by gathering and presenting site-specific data, to understand differences in perception and to identify which values people attach to places or elements of their living space. Recent experiences demonstrate that using GIS and other ICT tools can significantly add value to community mapping, allowing to uncover individual and collective neighborhood definitions [5] and to highlight local issues, planning priorities and needs, or identify development sites. In this way communities add information to the map themselves and act as sensors in their local environment [6].

3 Crowdsourcing Support in a 3D Environment

3.1 User Requirements

Even though our work concerns supporting different phases of participatory decision-making (e.g., see [7]), the current paper focuses on crowdsourcing. Domain experts (mainly urbanists) helped us to identify relevant requirements for the design of a Participatory GIS and they stressed the importance of centering the interaction model around the concept of Community Map, which provides an immediate and intuitive representation of indigenous spatial knowledge and needs.

The idea is that of using the community map both as a shared information source and as communication mean which enables group members to interact with each others and to access the shared information items. Thus, the members of a group should have access to a dedicated map for entering or searching for comments, documents and proposals (including drawings and 3D models) relative to the associated geographical area. In this way, the community map becomes a shared, dynamic information source which all stakeholders can use to overview and discuss the existing proposals as well as to collaboratively revise them. A main requirement is that the map provides 3D simulations of the environment and of the planned changes in order to offer a realistic representation of the intended effects of the proposed actions. Furthermore, the map should be the only reference for accessing proposals and feedback, thus supporting an integrated access to information. Obviously, other general requirements have to be considered. For instance, the availability of territorial data for the management of the community maps, the diffusion of the enabling technology for using the Participatory GIS (which should be accessible in internet from standard computers and browsers) and the provision of an intuitive user interface which supports a smooth interaction with the system without requiring technical skills.

We designed the user interface and the functions offered by GroupCollaborate2 by taking the above listed requirements into account; see the next section. As far as the basic requirements are concerned, we designed the user interface of our system in a user-centered way, directly involving domain experts and generic users who are not familiar with Computer Science. Moreover, for the representation of the community maps we decided to exploit Google Maps (and Google Earth), whose GIS layers describe geographical areas with reasonable precision and which can be easily enriched with layers displaying additional geo-referenced data. Google Maps are also largely accessible because they only require the downloading of the Earth plug-in in the user's browser to navigate the virtual environment and edit it. Furthermore, we based the authentication in the collaboration support platform on Google accounts, which are pretty diffused.

3.2 Sample Scenario

Let's suppose that, in the context of its future transformation plans, the Public Administration (PA) of Bruino city (IT) starts a participatory process to collect the population's needs and priorities and to solicit proposals regarding a peripheral area to be redeveloped. In order to collect suggestions, PA opens a discussion using a crowdsourcing platform such as GroupCollaborate2 and invites citizens and stakeholders (e.g., local associations) to join a focus group devoted it. The interaction with the platform is based on a Web-based Community Map of the town focused on the area under discussion, which enables users to (i) retrieve detailed information about the existing infrastructures, such as the presence of a road; (ii) upload comments, pictures and drawings sketching users proposals; (iii) edit or annotate user-generated content (e.g., project plans) to provide suggestions and comments; (iv) participate in geo-referenced discussion threads.

PA monitors the discussion space and contributes with opinions, suggestions and evaluations. A set of hypotheses for setting up or updating spaces are developed in collaboration with the population and are stored as a basis for a subsequent evaluation phase, aimed at selecting the most promising solutions through deliberation.

4 Our System

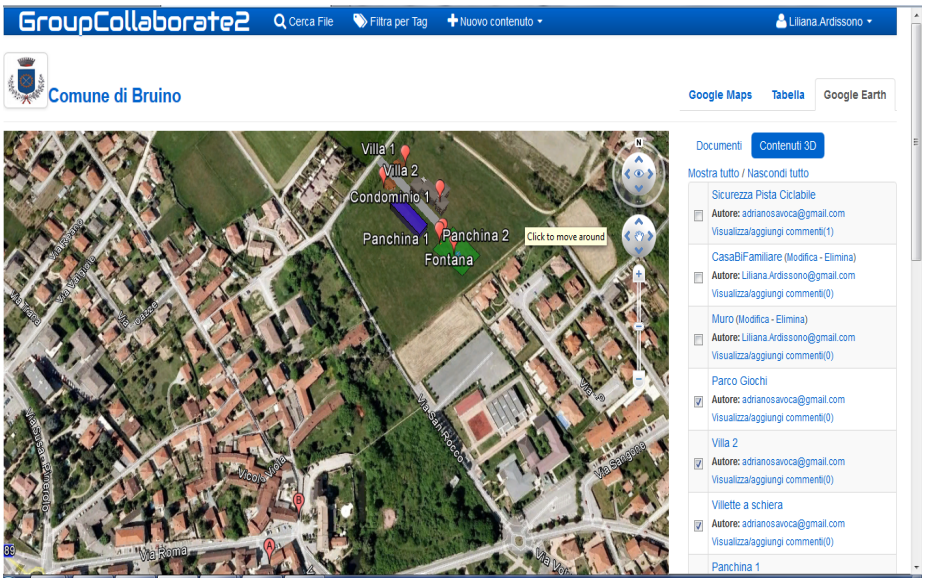

Fig. 1. Community map displaying geo-referenced documents (markers labeled with letters in the bottom part of the map) and 3D models (located in the upper part of the map).

GroupCollaborate2 contributes to the management of focus groups such as the one described in our sample scenario by supporting discussion and document sharing in

public and private groups. The system offers a user interface page devoted to the management of focus groups (users subscription, etc.). Moreover, it supports e-mail communication.

For crowdsourcing purposes each group is associated with a map representing the entry point to the shared information items. The map can be visualized as bi-dimensional or three-dimensional and is populated with the shared content. Figure 1 (in Italian), described below, shows the layout of the 3D community map for the Bruino group.

4.1 Information Visualization and Sharing Support

The community map enables users to share and collaboratively edit (possibly) geo-referenced objects of various types, including documents and drawings: 3D models are visualized as shapes and documents are identified by markers; e.g., see A and B in the central area at the bottom of the map in Figure 1. Moreover, each marker/3D model can be clicked to view its metadata (author, title and description; e.g., see the tooltip of "Villa 1" in Figure 2) or to open the associated document for reading/editing purposes.

The "Nuovo contenuto" (new content) link at the top of the page can be used to (i) create or upload a new document; (ii) upload a 3D model from a repository (e.g., a KMZ model), or (iii) draft a new 3D item by means of an editor which allows to sketch broken lines and polygons, select color and height of items, move, orientate and resize them, and set metadata. The right portion of the page displays items in a checkable list which allows the user to further select the elements to be shown in the map and to interact with them: e.g., open/edit documents or zoom the map on 3D objects (through the title), view the list of associated comments or add new ones ("Visualizza / aggiungi commenti"). The list also includes documents which cannot be visualized in the map because they are not geo-referenced.

Fig. 2. Zoom on a portion the community map displaying 3D models.

Figure 2 focuses on the 3D items uploaded in the map of Figure 1: “Villa 1”, “Villa 2” (hidden by the tooltip of “Villa 1”) and “Condominio 1” have been uploaded as 3D models; a red polygon representing a wall and a blue polygon representing a building have been drafted using the editor. The map also includes a green area drafted to delimit a playground with benches (“Panchina 1” and “Panchina 2”) and fountain (“Fontana”).

4.2 Information Search and Filtering Support

GroupCollaborate supports hierarchical tag-based item classification and filtering of documents and 3D objects:

- We introduced tag categories to manage different points of view on information: e.g., within a group, it can be useful to distinguish different types of content such as the masterplan of a project or general documentation. Tag categories can be thus defined to support different perspectives in the search for information. Moreover, for each tag category, a set of tags can be introduced to classify specific items in a folksonomy. All group members can define tag categories and individual tags by means of a dialog box supporting the hierarchical exploration of the tag system.
- The “Filtra per Tag” (filter by tag) link at the top of the map (see Figure 1) supports item search: it enables the user to choose a set of tags to be jointly used for selecting shared documents and 3D models. The search results are shown in the map, which visualizes the information satisfying the current filtering criterion.

The system also enables users to search documents by content (i.e., by words included in the documents) and by document name (see “Cerca File” - search file - link at the top of the community map). All these functions support the dynamic generation of community maps reflecting particular viewpoints; moreover, they allow reducing the amount of displayed information depending on users’ interests.

4.3 User Feedback on the System and Personalization Issues

We carried out a preliminary test of the system with a few domain experts and generic users who are not familiar with 3D environments and/or Computer Science but who are internet users, as this is the target expected to use a Web-based Participatory GIS. Users appreciated the functions offered by the system as they proved to effectively support both the introduction of elements to be shared in a focus group and the discussion activity on such elements, based on comments. The tag-based filter was considered very important to reduce the amount of information displayed in the community map, providing particular viewpoints on data.

Domain experts stressed the need to moderate user-generated content (something which is possible as group administrators). Moreover, they suggested to introduce new functions, such as:

- The introduction of subgroups to support the activation of specific discussion lines; e.g., among domain experts only. Subgroup modeling has two facets: (i) the management of restricted information access; (ii) the possibility that a user has multiple associated personae, and thus user profiles, in order to support her/his operations in different contexts.

- The management of user privacy in order to add anonymous contributions. This is particularly important if the system is extended to support voting, in which case also a trusted user authentication is mandatory; see [8].
- The introduction of additional communication channels, e.g., to enable the sharing of multimodal content such as voice comments and videos in the community map.
- The possibility for each user to access personal views on content based on concept selection; e.g., only scholastic buildings, or sport and leisure facilities. This aspect opens research paths on data representation (to classify content by concepts), user modeling (to understand the user's interests) and manual/automatic maps adaptation to derive personal views focused on specific interests.

From the usability viewpoint GroupCollaborate2 should comply with universal accessibility guidelines to support users having different abilities and using different browsers. In the current version the user interface is developed in HTML5 and has a neat layout to address the basic W3C accessibility guidelines. It is however clear that various features of the user interface could be extended to support different types of interaction. For instance, a library of pre-defined shapes and 3D models could be offered for dragging and dropping them in the map. Moreover, sophisticated tools might be proposed to draft complex polygons to represent buildings and architectonic elements having non-trivial shapes; e.g., see [9]. However it must be assessed whether technical users, who might want to produce such shapes, prefer to use specialized tools for this purpose.

5 Related Work

Social networks and Web 2.0 technologies are very used for supporting participation but they typically only collect textual feedback from users. For instance, urbanAPI (http://www.urbanapi.eu/) enhances participatory urban planning by coupling interactive information visualization for the presentation of project plans and of policy simulation results with the management of polls to elicit feedback about territorial policies. Similarly, WE-GOV (www.wegov-project.eu/), NOMAD (http://www.nomad-project.eu/) and FUPOL (http://www.fupol.eu/) deal with both communication and crowdsourcing but they collect people's feedback using textual interaction.

A few Participatory GIS projects enrich communication with 3D information in Virtual Reality (VR) or Augmented Reality (AR) environments describing proposed redevelopment scenarios. For instance, LIVE+GOV (http://liveandgov.eu/) combines AR and VR with social networks to allow internet users upload and receive geo-localized information about buildings and locations in a city, as well as participate in polls and discussions. Moreover, Min Stad (http://minstad.goteborg.se/minstad/index.do - a portal for the City of Goteborg), and partially PlanYourPlace [8], integrate GIS with social networks enabling users to upload 3D contents and to publish comments.

With respect to such works, GroupCollaborate2 lacks the support to deliberation provided by polls, which can be integrated with limited effort. Moreover, it has no direct connection to external social networks because it directly manages communication, integrating it with a richer type of crowdsourcing where users can share and collaboratively edit heterogeneous types of contents. Furthermore, our system supports thematic discussion groups, with consequent information hiding, w.r.t. to a generic upload and

visualization of information, the same for everybody. Finally, it supports the selection of the information to be visualized in the Community Maps through content-based and tag-based filtering, thus enabling their projection on different dimensions reflecting individual interests.

6 Conclusions

This paper presented GroupCollaborate2, a prototype Participatory GIS which enables the on-line management of discussion groups for participatory decision making. The described system enables users to share various types of digital content, including 3D objects, and to discuss it by interacting with a bi/three-dimensional Community Map supporting tag-based and content-based information search. The interaction with domain experts (planners) and generic users highlighted avenues for the adoption of personalization strategies, aimed at improving the interaction with the system and the access to information. For technical details about GroupCollaborate2 see [10].

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