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FirstLife: Combining Social Networking and VGI to Create an Urban Coordination and Collaboration Platform

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ABSTRACT Designing an urban platform intended to be a shared virtual space for coordination, cooperation, and collaboration among public administrations, local institutions, civic organizations, businesses, and citizens is an open challenge. This paper presents the current framework and applications of the civic social network FirstLife, developed following a participatory design approach and an agile methodology. The platform combines volunteered geographic information (VGI) with social networking functionalities. The results of a progressive validation with perspective end-users are explained in terms of the resulting features integrated during the evolution of the platform. Finally, the experimentation of FirstLife in several projects is described.

INDEX TERMS Urban platform, civic social network, participatory design, multi-stakeholder environments, space-time coordination, cooperation, collaboration tool, geoinformatics, VGI.

I. INTRODUCTION

Nowadays, with the widening of user friendly web platforms, expectations of the civil society to participate in local decision-making processes and to activate new forms of co-production and bottom-up services are raising [1]. So far, the integration of digital platforms in the urban management has been carried out mostly by public administrations in a top-down fashion. These platforms play a role which is still instrumental to support existing processes, rather than driving a change toward more collaborative practices among multiple stakeholders.

In the last two decades, geographic mobile and web technologies have become more and more user friendly, allowing a non-expert crowd of users to produce georeferenced data. The information produced in such a way is also known under the umbrella term of Voluntereed Geographic Information (VGI). Among others, these systems and apps are exploited by citizens and public administrations to report problems in cities [2], [3] (see also as examples: ImproveMyCity [4], FixMyStreet [5]). Although the benefits of these technologies for public management and urban planning are generally recognized [6], [7], their potential to support citizens' self-organization remains unexpressed [8].

Currently, both private and institutional actors are using the most common social networks to promote their work [9] because those platforms offer the opportunity to disseminate information and engage people at a seemingly affordable cost [10]. However, existing social networks have several limitations, particularly with respect to the type of social relationships they facilitate and support [11]–[13]. They mostly favor private connections based on friendship or shared interests. Also, they enable interactions at a global scale, which is valuable to avoid limits imposed by geographical distance, but they do not allow users to directly connect with their local reality. Application to cooperation in urban contexts is limited or focused on the citizens' private dimension, such as in the case of NextDoor.[1]

Additionally, it is common to have fragmentation of services across multiple websites - which results from digital tools designed for very specific contextual scopes. This affects the user experience and makes it more difficult to have an overview of what is happening in the city, as well as to create synergies among local actors towards common objectives in a shared working environment.

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[1] https://nextdoor.com/

The main objective of our research has been to design a digital platform which creates a shared virtual working environment, using geographic technologies, in order to: i) coordinate the initiatives of multiple stakeholders acting in the city, and ii) support urban management processes.

In this paper, we present the methodology, design and experimentation applied to the development of a local civic social network called FirstLife. The development of such a platform aimed to answer two main research questions:

1) How to design a platform to support cooperative work at an urban scale by combining social network functionalities and VGI?
2) How to support offline relations and self-organization in the urban environment through a digital platform applied to different contexts?

This implied that, besides managing technological challenges, we involved local stakeholders in co-designing and validating a digital environment in order to mirror as closely as possible the dynamics of real social contexts. By considering people's needs and supporting their different goals in a shared space, FirstLife integrates technical and functional requirements with the social requirements necessary for its acceptability by multiple stakeholders operating in the city. Acceptability has been tested in different real scale scenarios involving different kinds of users.

FirstLife, as other civic technologies, is oriented to be used as a coordination instrument by different stakeholders for sharing information about what has a public relevance at a local and city level for a plurality of people. However, it excludes contents related to the users' personal life, which instead are predominant in the most popular social networks. Moreover, as a crowdsourcing platform, FirstLife allows the collection of information from users, integrating it with heterogeneous data sources (open data, sensors inputs, etc.). The latter can contribute to build a richer informative environment, enabling the discovery of new insights about the city.

FirstLife as a service is supporting and has supported multiple projects. In particular, FirstLife provides a generalist platform (the civic social network) and multiple branch projects. The generalist platform is meant to make available the full use of FirstLife functionalities and sustain at city level all the public activities involving institutions, organized citizens, companies, etc. This reduces the aforementioned fragmentation limit due to the use of a multiplicity of platforms. FirstLife can also be customized for specific purposes or goals through the development of branch projects which may select a subset of functionalities without creating different applications.

The version of FirstLife currently in development is the result of a three-year work, during which heterogeneous groups of users helped to review the platform's baseline models and features. This has fostered the implementation of real-life scenarios and operational frameworks into the FirstLife development process in order to effectively support coordination, cooperation and collaboration.

The paper is structured as follows. Section II reviews existing literature on VGI and public participation platforms, while Section III presents the FirstLife conceptual models (user model, entities model and interactions model). Section IV illustrates the main features and functionalities of the platform, supporting coordinate, cooperative and collaborative work (described in Section V). Finally, we describe different applications of FirstLife on real-case scenarios on the territory (Section VI). Conclusions end the paper (Section VII).

II. BACKGROUND AND RELATED WORK

People are now more and more involved in the crowdsourcing of geographic data as *human sensors* [14], through the collection of georeferenced posts (i.e., Foursquare, Twitter), producing their own maps (i.e., Ushahidi, Google My Maps) or contributing to collective maps (i.e., Open Street Map, Wikimapia).

So far, geographic data have been classified differently depending on the way they are crowdsourced and the terminology employed to refer to this phenomenon has become extremely variegated [15] (see Figure 1). The growing number of keywords used to refer to Geographic Information (GI) can be considered as a sign of the increased complexity brought about by technological advancements in the field.

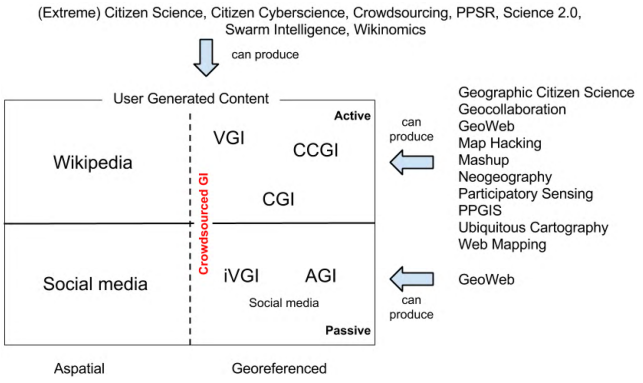

FIGURE 1. Analysis of the terminology found in the literature and the media. AGI: Ambient Geographic Information; CCGI: Citizen-contributed Geographic Information OR Collaboratively Contributed Geographic Information; CGI: Contributed Geographic Information; PPGIS: Public Participaton in Geographic Information Systems; PPSR: Public Participation in Scientific Research; iVGI: Involuntary VGI: Volunteered Geographic Information [15].

The emergence of these new data sources are the result of people involvement in mapping activities - a process that is blurring the distinctions between producers, communicators and consumers of GI [16]. These new sources of data are increasingly used by city governments not without criticisms on possible risks in terms of: surveillance and social sorting, corporatization of governance, technocratic rationals rather than social justice [17], [18]. Despite possible drawbacks, the direct participation of citizens in data production has the potential to enrich a decision making process with bottom-up perspectives. FirstLife has been designed to favor

public participation and collaborative work in urban contexts, providing quantitative evidences to a more informed urban planning and to connect people at a local level.

In the next subsection, before describing the development of FirstLife, we briefly review the state of the art of digital technologies supporting public participation.

A. DIGITAL TECHNOLOGIES AND PUBLIC PARTICIPATION IN URBAN PLANNING

Debates about the challenges of involving the public in urban planning, using geographic digital tools, can be grounded in the literature of Public Participatory GIS (PPGIS), which is extensively reviewed and framed in [19]. As Sieber [19] concludes, ''PPGIS provides a unique approach for **engaging the public in decision making** through its goal to incorporate local knowledge, integrate and contextualize complex spatial information, allow participants to dynamically interact with input, analyze alternatives, and empower individuals and groups''.

Ertio [6] classified types of digital applications used for decision-making in urban planning on the basis of theories of participation selecting three dimensions: *type of data collected*, *information flow* and *empowerment*. She underlines that, at the moment, participatory apps involve citizens mostly in tasks of data collection, even if they should include also the *map creation, personal analysis, interactive feedback, collaboration, and understanding of GI* [20]. Furthermore, it is still not clear how citizens' inputs are finally evaluated in the actual process of policy-making [6]. A limit of these tools, indeed, seems to be independent from the technology used but mostly related with the *amount* of power that the government decides to share with the public. Participatory processes can be limited to treat ''citizens as passive sensors, in a one-way direction, or as partners, contributing information in a two-way dialogue surrounding an issue and providing an opportunity for direct democracy, enabled by information technology'' [21]. Another way to look at the relation between digital technologies and public participation is through the notion of Open Government (OG). OG is a concept which combines e-participation and open data availability [22]. Some of the tools used in OG are explicitly related to geographic knowledge and discussion about local issues, such as reporting local problems (i.e. Ushahidi, FixMyStreet) or debating and ''liking'' proposals using social networks (i.e. Facebook).[2] Hansson *et al.* [22] organized a framework to review the literature related to OG, grounded in the three dimensions corresponding to the phases of the decision making process: understanding, deliberation, representation. The **understanding** phase concerns the collection of information from citizens through the use of technologies, as mentioned in Ertio [6], and, in the case of OG, it also stresses the *transparency* of government, associated to releasing data to the public. To this end, several Open Data Initiatives have been launched by governments in these years, gathering expert developers as well as non experts, in contests to produce apps aimed at solving certain urban problems. Citizens and developers, in these cases, work together and are involved not only in the data collection phase, but also in knowledge production, elaborating data to answer people's needs. The **deliberation** phase results in a collective and informed decision-making, mediated by supportive tools, generally focused on structuring the discussions and voting to record a decision, i.e., LiquidFeedback (`https://liquidfeedback.org/`), or on negotiations between stakeholders, i.e., in urban design, Geodesignhub - a powerful tool that allows users to visualize up to eight layers of territorial information on a map, and to add geographical primitives enabling teams to discuss urban designs [24]. Finally, that of **representation** seems to be the most underestimated issue in the OG literature, which presents the public mostly as an homogeneous group of people without considering social differences [22] and the stakeholders' perspectives.

To advance current technologies we propose to support citizens' collaboration and cooperation in a bottom-up fashion, by providing them with a tool that allows the understanding, deliberation and representation.

B. VGI APPLICATIONS

The spreading of user friendly toolboxes for making maps, from data collection to web map representation, provides people with the *power* of producing geographic knowledge by themselves encompassing their specific view of the reality. In particular, we can summarize trends in geographic knowledge production using the neogeographer's *toolbox* as in the following paragraphs.

1) DIGITAL COUNTER-MAPPING ACTIVITIES

Counter-mapping is a term that has been coined by Peluso [25] to describe a map-making activity by indigenous people in Indonesia. The need to counter the mainstream map making emerges when the voices of marginalized people are not taken into account in political discussions. Hazen and Harris [26] define it as "any effort that fundamentally questions the assumptions or biases of cartographic conventions, that challenges predominant power effects of mapping, or that engages in mapping in ways that upset power relations." Counter mapping practices make a large use of non-digital tools, however the possibility to collect and analyze data and to make maps through electronic applications has been explored [27]. A recent project of counter-mapping is the Anti-Eviction mapping project set in Los Angeles [28].

2) CITIZEN SCIENCE

Haklay [29] distinguishes six types of citizen sciences, highlighting to what extent it relates with neogeographer's production of VGI, and showing that the domain which better overlaps with it is that of environmental and ecological observations. Connors *et al.* [30] stresses the potential of VGI in the context of environmental monitoring; the author also reported that particularly in this field neogeography could be part of

[2]For a more accurate review, see [22] and [23]

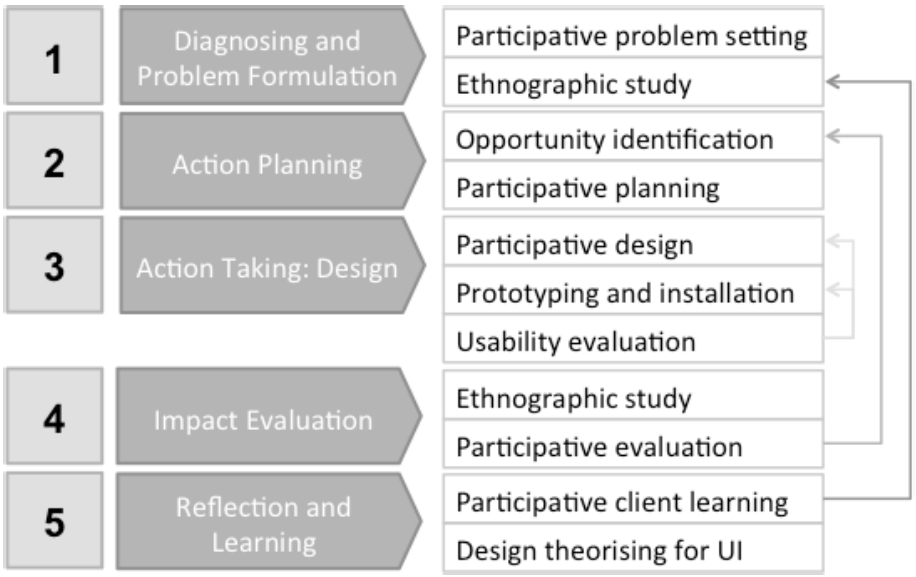

FIGURE 2. Participatory Action Design Research (PADR) [36].

a ''broader social trend that favors citizen involvement in decision making and policy implementation across multiple levels of government'' [31], [32].

3) CRISIS MAPPING

Zook *et al.* [33] report on the case that mostly exposed the potential of neogeography to support disaster response management: the Haitian earthquake. By analyzing some of the software that can be considered part of a neogeographer toolbox, such as CrisisCamp Haiti, OpenStreetMap, Ushahidi, and GeoCommons, the authors emphasize the important role that these sources of information played to support the logistics in disaster response. At the same time, they recognize that the success of any response greatly depends on the ability to aggregate and evaluate data for planning via logistical back support. Liu and Palen [34] give a review of the diverse and numerous types of systems used in disaster response including the participation of non expert citizens, from natural disasters to war and population dynamics. Haworth and Bruce [35] record an increase in the trust that authorities have in crowdsourced data and, as a consequence, in the geographic knowledge produced.

III. THE CONCEPTUAL MODEL

The main objective of FirstLife is to design a collaborative environment for citizens. In order to be effective in different operational contexts it has to be compliant with stakeholders' needs. This section introduces the methodology we used to collect requirements and the resulting conceptual model.

A. FIRSTLIFE DESIGN METHODOLOGY

The definition of the model and the development of the platform is a challenge on his own. FirstLife design and development adopted from the very beginning a user-centered design approach through participatory design cycles that continuously feed the platform. Our methodology is grounded in the principles of Participatory Action Design Research (PADR) [36], depicted in Figure 2. This led to a collaborative digital environment designed on the context's constraints and opportunities and on the stakeholders' goals.

The conceptual model behind the platform is the result of three-year work, where multiple testing and validation phases, involving several heterogeneous user groups, have led to the definition of the formal structure presented in this section [37]–[39]. The analysis of user requirements, stemming from the continuous engagement of users during the design process, entailed subsequent steps of comparison, evaluation, organization based on abstractions of common elements in different user patterns, then a generalization and systematization of specific functional requirements that should be addressed in the software development. In detail, this process can be divided into two main phases: the living lab phase, and the workshop phase.

The living lab We started with the preparation of a living lab [40] that involved 100 local actors, that were: organized citizens, members of associations, foundations, companies, universities and schools stakeholders. The living lab was organized to allow those that actually participate to the urban life of the city of Turin, or simply inhabit it, to work together for finding opportunities and challenges for the design of the platform. Participants were grouped into mixed teams to discuss a set of selected topics from their point of view: services accessibility, group coordination, local promotion, events management, activities documentation. These topics were connected to the opportunities offered by crowdmapping technologies and focused on the city of Turin. Given one or more challenges to deal with (either defined by the participants themselves or suggested by the coordinator),

the participants were asked to collectively reflect on possible solutions. The living lab lasted an entire day and was held at the University of Turin. As a result, participants raised concerns about the limitations of existing social networks in relation to public goals and collective actions. They eventually provided a set of requirements which can be summarized in the following themes:

1) *entities*: participants emphasized the importance of two main types of entities with reference to the urban environment, namely places and events. These drove the definition of the entity model (see Section III-C). Entities were further defined in relation to their properties: for instance, whereas places were thought as stable entities that should always be visible in a map-based application, events were conceived as temporary, being bounded to a specific time interval; further, events were perceived as referred to a specific organizer, whereas places were conceived as public belonging to the entire community.
2) *visualization*: participants expressed the need to aggregate entities of the same type by using easy-to-understand representations and to display all the data present in the system on a map-based visualization (see Section IV-A). They further noticed that information should be visualized through progressive levels of details, whereby the user should have control on the granularity of the information displayed.
3) *filtering*: participants restated the need to exert control upon information suggesting that the system should allow them to filter the data to be displayed. They also recommended that entities should be divided into different categories in order to allow for a fine-grained search of places and events.

The workshops During the second phase, we continued engaging local stakeholders in design workshops in order to refine requirements and validate the model. An important goal during this phase was to define use cases with potential users, in order to model features that were responsive to the expectations and needs expressed by local actors. We carried out 25 workshops involving on average 15 participants each, lasting at least a cycle of two half-day seminars or labs, in four districts of the municipality of Turin. We worked with groups on how to use the entities and functionalities that we were designing in connection with some scenarios proposed by the participants. Those scenarios were related to their roles, activities at local level and public goals. We involved either homogeneous groups with members characterized by similar objectives and ways of acting in a public dimension (local authorities, non-profit organizations, students), as well as mixed groups of individuals sharing the same neighborhood or city area. During the workshops, participants were also invited to think about what people usually mean with public or private information, appropriate and inappropriate uses of the most common social networks, parallelisms and divergences in global virtual life and local daily life. This design work allowed us to define a set of application scenarios based on participants' activities and to gather further requirements about information management in the system. This allowed to evolve the system design by suggesting a variety of insights that can be summarized in the following themes:

1) *entities*: places and events could not embrace the variety of entities connected with the territory. News, extra and groups are further relevant entities (see Section 3.3). It also emerged the need to define more than one categorization for each entity, as a unique category was perceived excessively rigid.
2) *filtering*: it emerged the need to provide multiple views on the same information base, for example by filtering through space and time, or by providing a group view and an individual view.
3) *connections*: participants pointed out the usefulness of tying together different entities, also foreseeing sub-entities that could be put into main entities.

In the following sections, the results of the participatory process depicted above, in terms of user and entity models, are described.

B. USER MODEL

The user model is based on the fluidity of roles [41] that each user plays in different networks coexisting in the same space, also if at different scales.

Starting from empirical evidences and the input collected during the participatory process, and also taking into account the framework of the platform as civic media, three main networks have been identified for each user:

- The *professional* network including all the work-related relations distributed in a range from the building to the regional level and over.
- The *territorial* network including the personal and political relations, whereby for political we mean all the relations built with active participation in opinion formation, decision-making processes at local level, management of shared resources, informal leaderships, etc.
- The *community* networks including membership in local groups or non-profit associations, assuming that each user can be involved in a plurality of communities.

Each network calls for a different ''signature'' of the user related to the role played when sharing an information. The evidence given on the platform to the user role in real-life allows other users to assess the value and reliability of the information. An example of this model is a user who owns a shop, that is an advisor at a local citizens' committee and that is a member of a local sports association. Moreover, we considered that roles in each network can be transitory, but the signature on the shared information while playing a specific role must instead be fixed to offer a correct interpretative context to other users. For example, information published by a user that was member of a local committee is still valid, even though the user is no longer a member of that committee.

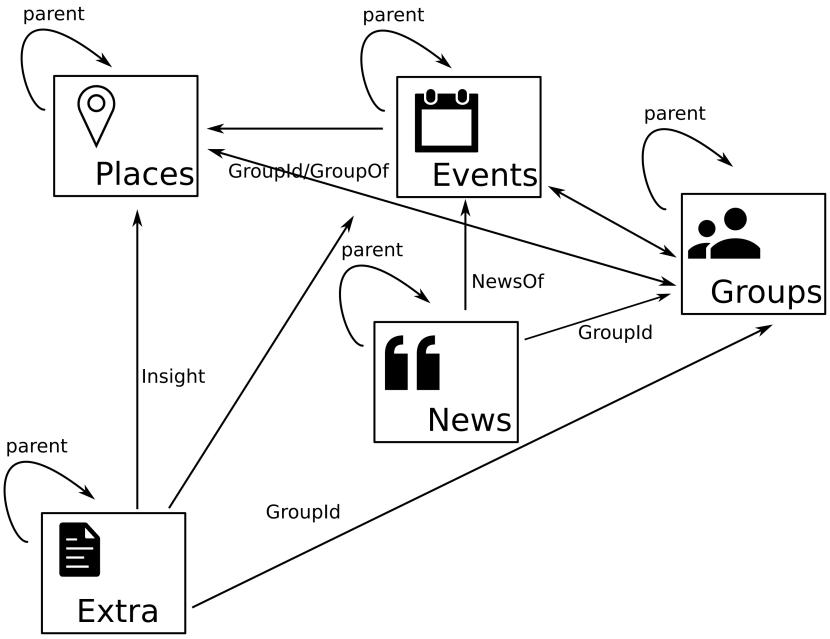

FIGURE 3. The entity model of FirstLife. It defines five first level entities: Places, Events, News, Extra, and Groups.

C. ENTITY MODEL

Urban environments are constituted by complex entities that can be represented in a variety of ways, corresponding to the different views on them that different users may have. Indeed, the fundamental characteristic of urban entities is to have a physical presence, even if ephemeral [42], and to be a social construction [43] shared within homogeneous groups and among heterogeneous ones. The entity model has been inspired by human geography studies: the notions of *space* and *place* have been considered as the opposite extremes of a continuum which goes from the ideal geometrical abstraction of space to the experiential world of place [44]. Given this context and the purpose to model social entities on the map, we approached the complexity of this domain in different ways. First, we focused on social actions, by structuring entities on the basis of the type of information tracing these actions. Then, we built modular entities, which can be aggregated in different ways to represent different concept types. Finally, we observed that entities can have a temporal dimension to express their possible ephemeral character.

Figure 3 depicts the entity model of the FirstLife platform, which includes five types of *first level entities*. *Places* include facilities hosting public services and utilities, buildings or spaces used for open events and community activities, areas chosen by associations, organizations and companies to implement new territorial projects, points of interest from a socio-cultural perspective, etc. As a civic social network, we do not focus on private and residential places, but we promote an active involvement of associations, as well as commercial and productive activities in relation to their contribution to the local development (see Section VI). *Events* are meant as public events of any type and scale, which includes traditional events such as concerts, exhibitions, festivals, but also micro-events and spontaneous initiatives at the neighborhood scale, that usually do not leave any trace on newspapers and traditional communication channels. By enabling every user to create a new public event, the platform supports bottom-up activities and an active citizenship. Events on the map create a global calendar of the territory. *News* enable to share notices, announcements, calls and news of local interest, while *Extra* are stories, novels, projects, testimonials, reports of activities that are linked to the area in which the users live. Finally, *Groups* operate as virtual units to enable coordination and self-organization of actions in real-life. They enable the sharing of useful information with other groups' members in real time.

Each type of first level entity can be described by a set of core and specific properties, providing the user with a homogeneous way to represent real word concepts. The core properties include the name, the description, the user who created it and the last user who updated the entity. Each entity type may also have specific properties, for instance events have starting and ending dates, duration, an organizer, a list of attendees and a performer. Moreover, an entity has a temporal dimension since it may exist in a specific time interval or not. For example, an artistic installation placed in a square should be included (and visible) in the map only during the time interval of the temporary exhibition to which it belongs. On the other side, a place like a church should always be included in the map, regardless the considered time interval. For this

reason, our model allows to associate to every entity a time interval within which it is valid.

All entities can be classified using domain-expert knowledge by using categories, while tags allow the users to create a crowd-based entity description. In details, our model introduces a multi-dimensional category system, allowing the definition of multiple categorizations for each entity type in the general platform and in each branch project, overcoming the limits of a single categorization of entities that does not fit with the objectives and the requirements of specific projects. Each category space is also mapped in a common tag space, theoretically enabling the shift of data from a branch project to the main platform. This technical solution will enable in the future to customize the category sets for different stakeholders, creating multiple parallel working environments but one final collector of shared information.

Multiple spaces of categories generate multiple map themes, allowing users to explore the map from different perspectives. In addition, tags allow to describe the key characteristics of entities from a user-centered perspective enabling the creation of a crowdsourced knowledge base. The use of tags overcomes the limits of closed categories and extends at the same time its semantic.

First level entities introduced above can be enriched with *second order entities* such as posts, images, polls and descriptions. They allow users to contribute with information reflecting their specific perspectives.

1) AGGREGATING ENTITIES

Starting from single independent entities, we implemented a set of *relations* that can be used to connect entities, enabling the creation of complex urban entities (see Figure 3). This mechanism generated the so-called nested entities or sub-entities, configured as a main entity (the first added to the map in chronological order) and a set of entities potentially organized at different depth levels, but with the same set of properties and features of the parent entity. For example, when a user adds an entity to the map - defining its title, categories and description - other users may add sub-entities to the parent one, integrating it with more detailed information, or additional events.

The scheme of nested entities resulted to be effective in representing complex urban entities (see Section V), such as buildings hosting multiple services or big events like festivals constituted by a series of sub-events, relying on the patterns: place-sub-places, event-sub-events, place-events, event-places. The introduction of News and Extra has greatly increased the expressiveness by relying on the relation Place-Extra or Event-News, to support projects oriented to collect community memories or to document an event with its day-by-day updates. This pattern defines what we call the entity's *newsfeed*, expressing all events, places, news, etc. strictly related to the main entity.

Moreover, our model can go further, avoiding the planning effort for the user in the definition of a hierarchy of entities in advance, by introducing initiatives. They allow to group together a subset of entities, representing independent actions made by different stakeholders toward a shared goal, which can be known from the beginning or not.

IV. THE PLATFORM

FirstLife[3] is a web application accessible via browser both from desktop and mobile devices. In this section we briefly describe how contents are visualized, searched, added and enriched with different users' point of view.

A. VISUALIZATION, FILTERING AND SEARCHING FOR CONTENTS

The main FirstLife interface is composed of a map and a side wall, containing summarized entity details represented by cards. Single entities can be opened by clicking on map markers or on their summarized card on the wall: this will open a detailed view that shows all their properties (such as categorization, description, linked URLs, etc.), their sub-entities, the initiatives they are part of and the second level entities related to them, i.e., posts and comments.

The web interface has been conceived to offer the user complete control over what she wants to visualize on the map, with the possibility to filter contents using different dimensions at the same time:

- Space, by selecting on the map a bounding box and a zoom level;
- Time, by defining the validity of entities in terms of time intervals;
- Content, by selecting
  - The main type of first level entities (defined in Section III)
  - The category
  - Properties
  - Tags defined by the user

The map represents a filter selecting which entities are represented in the side wall, allowing to focus on the whole city up to a single building depending on what the user is looking for. The search bar allows to search either for an address, or strings present in the entities, or names, or tags. The detailed card has a link to center the map on something that has been reached in this way. Figure 4 shows the side wall and an example detailed card.

In addition, the platform can visualize the subset of data corresponding to the user map (containing all the contents generated by the user) or the group map (all the contents generated by a group's members).

To interact with the multi-dimensional category system with two levels tree maps were adopted. In this way, we can manage the selection of theming (see Figure 6 for an example of categorical theming) and list of categories without scrolling a long list of items to get an idea of the classification system and interact with it to filter map entities.

[3] http://www.firstlife.org/

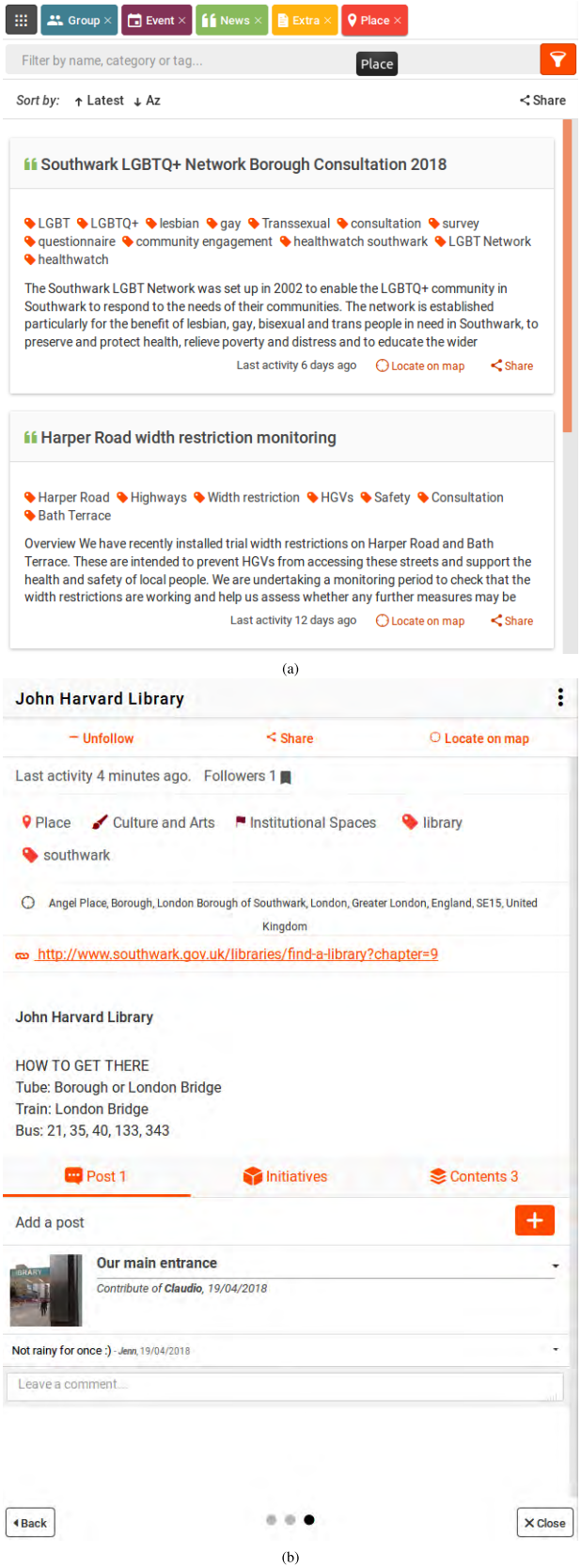

FIGURE 4. First Life's side wall: (a) with the list of markers selected by the active filters and (b) with a detailed card.

B. ADDING CONTENTS AND BASIC INTERACTION WITH FIRSTLIFE

Entities can be added to FirstLife via a stepwise wizard that guides the user in selecting the requested categories for the chosen entity type, writing a title and description, choosing (if applicable) a time span of validity for the entity and adding free tags or URLs to further characterize the content.

After that this step is completed by one user, other users can contribute adding their opinions in the form of posts, having a title, a text and an optional image or comments. Ideally, the basic characterization of entities should be an objective description, while posts are devoted to subjective contents (see section III-C). Moreover, users can collaborate by enriching entities with sub-entities, enabling the creation of complex urban entities.

Users are always aware of the activities involving their interests: indeed, they can receive notifications (see Figure 6) regarding new activities (added posts, comments or sub-entities) related to the entities they are interested in by following them.

1) GEOLOCALIZATION AND AREAS

Entities in FirstLife are not only referenced to a single point in space [45]: adding something in the same geographical coordinates but at different zoom levels of the map will link it to different areas (a single building or road, a whole block, neighborhood, the entire city, etc.). This adds a further dimension to model reality: for example, an event could take place in a single building, but a news could be of interest for a whole neighborhood. When an entity is added, the selected area is highlighted (see Figure 5) to show users the context the new content will be linked to.

C. CLUSTERING ENTITIES

Since the markers on the map can become too crowded, depending of the chosen zoom level, we decided to join them in a single marker when they would be rendered too close to each other. To keep the map expressiveness given by single markers that are different in shape and color, for the five main types of entities, the ''clustered'' markers are represented with a pie chart showing the total number of entities clustered and the relative abundance of their types via their color code. The types depend on the thematization chosen by selecting the category dimension to be shown. Figure 6 shows an example of clustered and scattered markers, with and without thematization.

D. IMPLEMENTATION

The FirstLife's development process follows an Agile methodology with very fast sprints, in order to maximize the delivery, implement and test new features in accordance with the timing of different projects (see Section VI). The FirstLife's frontend has been implemented using Ionic and AngularJS, maps are represented using the Leaflet

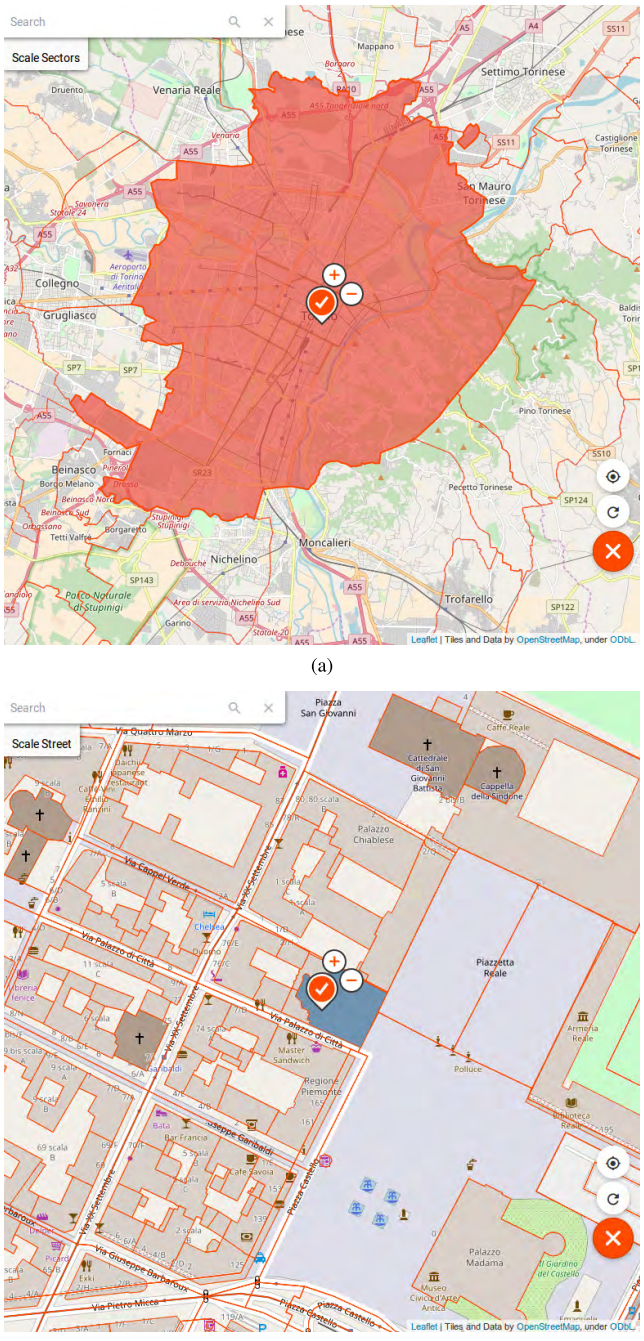

FIGURE 5. Adding entities at different zoom levels: the city level (a) and the street level (b).

FIGURE 6. First Life's interface: (a) annotated with the main characteristics and showing examples of markers' clustering.[5] (b) with thematic icons activated for Places - one Monument/Historic Site and two Institutional Spaces - based on categories in FirstLife.

library [46]. The backend of FirstLife is developed using a NodeJS based framework by IBM, LoopBack, providing a REST layer connected to the data sources through a model-oriented software, StrongLoop, which converts models in database structures. Moreover, StrongLoop works as an abstraction layer between the business logic and a cluster of databases. Currently, we use MongoDB, a NoSQL database based on JSON documents. The choice of a NoSQL database allowed to follow an agile development strategy where the stored data structure can evolve over time still retaining good performances of geographic queries.

The backend can be invoked by the client or third-part applications via API REST. FirstLife APIs uses a JavaScript Object Notation (JSON) as message format, in particular an extension of JSON meant for geographical entities:

GeoJSON. GeoJSON is a standard format for geographical data, supported by all major GIS and web GIS software, which helps in term of interoperatibility, a strong requisite for institutional subjects, who are willing to provide data sources only if they can easily access to users' contribution on their data.

V. COORDINATION, COOPERATION AND COLLABORATION

FirstLife functionalities aim to enable crucial coordination requirements for a Computer Supported Cooperative Work (CSCW) system [47] such as the management of task interdependencies and common information spaces. Differently from map services like Wikimapia and Open Street Map, it is explicitly aimed at supporting cities and public institutions in carrying out collective initiatives at a local scale. The main challenges of deploying a tool of this kind is to overcome the system's ''cold start'' reaching a sufficient amount of information collected and users participating that may push the large-scale adoption of the system. Users may be motivated in using FirstLife by the opportunities for contributing to the urban life of their city, as well as by the possibilities of finding support to their initiatives.

More precisely, the use of FirstLife in real-context scenarios has provided three main dimensions of support: coordination, cooperation and collaboration. While coordination is intended to arrange the preconditions to cooperate and collaborate, the difference between collaboration and cooperation is more subtle. Teasley and Roschelle [48] describe cooperative work as a task that is accomplished by dividing it among participants, where ''each person is responsible for a portion of the problem solving,'' while they see collaborative work as ''the mutual engagement of participants in a coordinated effort to solve the problem together''.

In the next subsections we present an assessment of the platform's functionalities in terms of both allowing the division of a task in sub-tasks among users (cooperation) and easing the sharing of common goals (collaboration).

A. COORDINATION

The visibility of entities shared on the map allows users to have an overall view of what is happening in the area of interest. On the one hand, the underlining platform's model (see section III) responds to the need of integrating heterogeneous information on a geographical basis which are currently scattered across many providers, i.e., institutional portals, organizations websites, Facebook pages, etc. On the other hand, the possibility of filtering information by space (map zoom and bounding box), time (timeline and global calendar), and content (properties, tags and categories) tames the complexity of overcrowded maps [49]. Furthermore, entities are updated in real-time to facilitate coordination and planning at multiple scales (neighborhoods, districts, city) and at different time intervals (hours, days, weeks, months).

In FirstLife, differently from other social networks, users cannot be followed directly, also considered the sensitiveness of privacy issues concerning the position of users. Relations within the users' networks are created indirectly via their interaction with the map entities. The types of social network functionalities can be listed in terms of user's interactions as follows:

- follow an entity to receive updates, via the notification mechanism;
- add posts, comments, or sub-entities to an existing entity, that will be notified to followers of the entity;
- join a group;
- share the URL of an entity;
- share his/her own map;
- claim the ownership of an entity.

Overall, FirstLife provides a basic decision support system [50], [51] favoring public and private organizations, as well as citizens, to easily access information about: past, present and future events and the main transformations that are taking place in cities directly on an interactive map.

B. COOPERATION

By defining groups as entities, the platform addresses the management of task/activities based on the mutual awareness of what is happening in a common information space where people are working together for a limited period and for a specific goal. The added value of groups stands in the opportunity they give to each group's member to be constantly updated about changes in their specific information space. A group map can be seen as isolated from the other data showing only what is needed to be known by the group itself. At the same time, all contents added by groups' members are public favoring intra- and inter- group coordination. Offline activities (see living labs in Section III-A), during which users were engaged, demonstrated the potential of having groups as basic operational units to organize and communicate about on-going activities.

Besides groups, cooperative work is addressed by the introduction of initiatives within the model (see Section III). They allow to associate entities of every types to a specific initiative carried out by the users. As in the case of the group entity, initiatives allow for the filtering of information related to that particular task or activity, i.e., cleaning up the neighborhood's park. At the same time, initiatives do not require all the descriptive information needed in the case of the creation of a proper entity and users do not have to be members.

In light of this, while groups are more adequate when the coordination task/activity is delimited in time and space and involves a specific group of users, initiatives are more open, favoring a broader people engagement in participating to the work.

C. COLLABORATION

The definition of the content-based relational model led to the implementation of a collaboration framework where users could be made more aware of the different or shared perspectives on the same entity. Although the essence of a

crowdsourcing platform is that every user can contribute with her own viewpoint, the perceived ''right'' to write about a place or an event may determine uncertainty about who is more entitled to provide the most basic characterization of an entity. To overcome this problem we introduced nested entities: a hierarchy between first order entities that have an hidden initiator, and second order entities each of them belonging to a different author who is responsible for moderation only about her specific contribution. Therefore, multiple parallel descriptions of a single entity are associated to their authors' viewpoints which express their personal experiences and activities. The collaborative approach that FirstLife favors reverses the approach of collaborative platform such as Wikipedia, where the goal is to reach an agreement among contributors on an objective description of a subject.

VI. EXPERIMENTATION

A. USER TEST

To gather initial feedback about FirstLife we conducted a formative study with ten participants in order to discover usability and accessibility issues and gather insights on the perceived opportunities opened by FirstLife.

1) PARTICIPANTS

We recruited 10 users (U1-U10) through emails and snowball sampling. Participants (Females=4; Average age=34; SD=8.3) used the generalist platform and reported on their experience. The aim of the study was explorative and qualitative in nature. We followed a purposeful sampling method [52], balancing the sample with reference to age, profession, and city zone in which participants lived (e.g., city center, peripheral neighborhoods, satellite towns) in order to increase its heterogeneity. All participants lived in the city of Turin or in the immediate surroundings. The sample size is in line with other studies with similar goals and design (e.g., [53], [54]). However, the decision of settling for 10 participants came when we realized that additional data would not have produced substantial new findings for the goals of our study, following a data saturation criterion [55]. The majority of participants were well educated and relatively affluent. All were relatively unfamiliar with crowdsourcing systems. All self-reported as experienced Internet/PC/mobile users.

2) PROCEDURE

The researcher first presented FirstLife. Then, each participant could freely use the system for as long as she liked, exploring its functionalities and contents. Then, the participants had to complete three different tasks: one exploratory task, in which they had to find a precise content, i.e., a second order entity (a post), in the system by navigating the map; two crowdsourcing tasks, in which they had to insert two different entities in FirstLife (a place as an entity and a group as a sub-entity) specifying their characteristics (e.g., the categories to which they belonged, the textual description of the entity, etc.). After completing the tasks, participants could further use the system as long as they wanted, further reading, inserting or modifying contents present in the system. The average period of engagement was 60 minutes. Participants gave feedback on FirstLife in a thinking-aloud format, speaking freely as they examined its features. The researcher observed the interaction and documented the progress of each session keeping records of the participants' comments and difficulties. All the sessions were conducted by the same researcher. At the end of the session participants had to complete a short questionnaire providing subjective measures about the use of the platform. More precisely, we asked them to report about:

- Usability: We defined five Likert-scale questions specifically addressed to assess crowdsourcing functionalities of FirstLife, asking the users about i) ease of map navigation, ii) ease of inserting new entities, iii) ease of inserting new sub-entities, iv) ease of finding specific information, v) understandability of categories when inserting a new entity/sub-entity.
- Likeability: This targeted whether users liked aspects of the interface, and included two questions: a) whether the users liked FirstLife interface, and (b) whether they liked the visual aspect of the map.

Finally, participants were interviewed for 30 minutes. Interviews were semi-structured and had the aim to: i) gather insights about potential usability and acceptability issues, starting from the scores given in the questionnaire; ii) explore potentialities of FirstLife to increase participation to the life of the city in which participants lived. All the thinking aloud sessions and the interviews were audio recorded. Data were then transcribed verbatim. Results from the interviews and the thinking-aloud sessions were analyzed together through a thematic analysis, following open and axial coding techniques [56]. Results were coded by taking apart sentences and labeling them with a name. Then, findings were grouped into three main themes.

3) RESULTS

a: USABILITY AND LIKEABILITY

Participants reported that navigating the map was easy: the Likert average was 4.1. Almost all the functionalities were clear in their working principles. A partial exception is related to the entities filters that allow the user to visualize only specific subsets of entities: even if participants reported that they were understandable, they also emphasized that they were barely visible in the interface (e.g., icons were too small). Moreover, a minority of them (3 out of 10) highlighted that ''They should work in the opposite way... I should be able to select what I want to see on the map, rather than deselecting what is not relevant to me'', U2 said. As a result, finding specific information was perceived as easy (the Likert average was 3.9), and the filters were reported as useful, but not all the participants exploited them to ease the information retrieval process (3 out of 10 did not use them): this was likely due to the issues highlighted above.

Participants encountered problems in inserting new entities (Likert average 2.7) using the stepwise wizard. They found it difficult to proceed and complete all the steps for inserting entities and defining their properties, as not all the form labels were perceived as clear. Moreover, the form fields required a minimum number of characters to be completed (for example, the textual description of the entity), which was perceived as limiting the user's freedom of choice: ''I understand that constraints are useful to invite the user to insert all the information needed, but they limit my freedom, you cannot force me to say something... it should be better to use some presets, for those fields that a user does not want to complete'', U3 highlighted, expressing a shared opinion (6 out of 10). This slowed down the insertion of the entities, and has been reported as a reason that could undermine the gathering of information from the crowd, especially from those users that ''are not fully motivated to contribute, as velocity is fundamental to encourage people to participate'', as U9 said. This points out the need of finding novel mechanisms allowing users to extensively contribute to the population of the map, without making them feel constrained. However, the insertion of sub-entities was perceived simpler (Likert average 3.7) showing that FirstLife was easy to learn: this was confirmed also by the participants' interactions with the system observed after the completion of the given tasks, whereby they engaged in inserting new entities to map their neighborhood.

Categories, which had to be ascribed to entities during the inserting process, were perceived as understandable (Likert average 3.4). Nonetheless, a minority of participants (3 out of 10) specified that they were not exhaustive, as there were concepts, in their opinion, that could better describe their characteristics. The possibility of adding tags, however, was considered an optimal remedy by the majority of participants in order to increase the flexibility of the categorization and widen the semantic field of the entity.

For the two likeability questions, participants showed a favorable attitude toward both the interface (Likert average 3.6), and the visual aspects of the map (Likert average 3.9). The aesthetics was considered ''minimal'', ''clean'', and ''elegant''.

b: CREATING MULTIPLE FORMS OF KNOWLEDGE

During the interviews, participants emphasized that FirstLife could be a tool for increasing the sense of citizenship of individuals, as they could find a unique place where contributing to the development of the knowledge about their city.

Six participants pointed out that common tools for exploring a territory are focused on ''commercial or utilitarian information'', ''such as how to find a shop, or how to reach a place, finding the shortest way. It seems that everything is made for speeding up, or buying, or for tourism, internet maps are often endowed with this sort of ideology. I like instead this map that is made to create a memory of the city... it allows people to describe the places and the initiatives that they think are worthy to be seen, not merely for tourism or to be consumed, but for the citizens themselves'', as U8 exemplified. FirstLife, therefore, has been perceived as an instrument that may enable the creation of alternative forms of knowledge, based on what citizens feel important to be signaled and remembered, reflecting their own values and beliefs.

Further, the majority of participants (7 out of 10) particularly appreciated the possibility of connecting different entities through relations that may create nested entities. U10, for instance, emphasized that ''this mechanism allows forms of knowledge organization that really mirror what people think... I mean, there are no predefined hierarchies, but people can propose their own ways of connecting places, groups, events, in ways that represent how they see things and how they think... I can put a place within a group, or a group within a place depending on whether I want to give more importance to the place in which the group is meeting, or to the group itself''. This freedom, which, in participants' opinions, is lacking in other map-based services, is also testified by the possibility of maintaining different perspectives on the same entity, instead of pursuing a common agreement: ''I like the fact that a place or an event can be described in different ways by different people... It opens up the city to different views, instead of providing a unique interpretation... It makes the map your map, the map of your city, I mean the city that I see, or that I am interested to seeing'' U5 said. However, a minority of participants (2 out of 10) highlighted that in certain cases a form of ''authority'' could be necessary: ''What about if my place, for example the gym in which I teach, is described in ways that are not true... I should be allowed to cancel or correct those descriptions, I think that a sort of ownership for some places is in need, it's also a matter of responsibility'', U8 said. This points out that FirstLife may arise tensions between freedom and control over knowledge, and that letting people be completely free may go against the individual's needs (e.g., those of the owner of a given place).

This urban knowledge may also change how the city is perceived, making its ''life'' more visible. The majority of participants (7 out 10) highlighted that the possibility of ''following'' the entities placed on the map and be updated in real-time about their changes could help people become more aware of what is happening in their surroundings. This, on the one hand, would increase their sense of belonging to a particular place as U6 noticed. On the other hand, it would allow for new forms of aggregation on a local level: ''It would be possible to signal an event that is happening and somehow calling people nearby... or being advised that something important is going on in a specific place that we love'', said U1, whereas U3 added ''it could be useful for encountering new persons on the basis of what is going on in the places I'm passing through''.

c: ENCOURAGING LOCAL ORGANIZATION

Participants reported that FirstLife could further strengthen the individuals' sense of citizenship by fostering people to collaborate on a local level. To this aim, groups were perceived as an important means to tie people together and to support them to reach a common aim. U7 suggested that

"I think that such groups should be shaped along the idea of enclosed spaces of intimacy... I'm saying that groups in Social Networks like Facebook end up to be a conglomerate of people that do not know each other and simply follow some news... Here, instead, I think that these groups, by being local, could help people make things together". By being based on specific locations, FirstLife's groups seem to evoke a sense of closeness lacking in other Social Network Sites. Some participants suggested that groups could be further structured as they were small organizations, with roles and rules. U1, for instance, noticed that "There is a lot of potentialities here to support citizens in taking care of their city... I think that these groups should remain small in size and allow forms of self-organization, like letting members decide whether to allow new members to enter, or set some rules and duties".

It seems, from participants' recounts, that such forms of aggregations could also be short-lived, specifically built to reach a specific goal, such as the cleaning of a garden, and then rapidly dissolved or addressed to another objective which may entail the engagement of new members. U4 emphasized that "I think that having the opportunity of creating groups and initiatives from below could really change how we live the city... It could make us feel being part of our neighborhood without requiring a strong commitment", whereas U7 said that "They may be short-lived but at the same time connect people together and make them feel part of a community... I think that often we do not put much effort in taking care of our city because we think that this would require too much time... But these groups could be a means for being involved for a while, then disconnect, and then being involved again... If we have a variety of groups we could join them when we have time to pursue a particular aim".

To summarize, participants find out a series of usability problems to be fixed in the subsequent version of FirstLife. They also preliminary confirmed that the system can support coordination by providing real-time knowledge, collaboration by offering opportunities of creating a multiple knowledge, and cooperation by favoring citizens' initiatives that may change the city life. In doing so, participants also reflected on the possibilities opened by FirstLife and suggested some future developments.

B. REAL-WORLD PROJECTS

FirstLife has been also tested in several projects focused on many different domains, to assess its flexibility. Development went on in parallel with its usage in these real-word projects, discovering and implementing needed features (e.g., the multi-facet descriptions of entities and the multi-dimensional categories for TeenCarTo, Extras and signatures) that were not initially available and adapting the model and the interface to the newly arisen users' needs.

The majority of the trials have been performed in and around the Turin area, a large post-industrial city in the north-west of Italy. The urban municipality itself has roughly 900.000 inhabitants but the whole metropolitan area, covering 2.300 km^2 of interspersed little towns, arrives at roughly 2 million. When the industrial productions moved away its main productive activities steered to services. Nowadays it is a lively city, with two big Universities - after the Winter Olympics held in 2006 it's also gaining touristic interests, mainly focused on its architecture and museums (with the second largest Egyptian museum after the one in Cairo).

During the last three years ten heterogeneous projects adopted FirstLife, ranging from a crowd and sensor-based information system about safety hazards and good practices in chemical and medical laboratories ([57]) to urban regeneration efforts focused on directly involving citizens in small initiatives spread around their territory in order to re-think the use of public spaces.

Here we focus on three of these projects, selecting those more interesting in terms of cooperation/collaboration and at different stages of their evolution in order to highlight different aspects of the relationship between FirstLife development and its application in different fields.

1) TeenCarTo

The TeenCarTo project aimed to promote web education in schools and collect information about the teenagers' point of view on Turin, Italy. It was founded and supported by the department of Youth policies of the Turin City Council, which had interest in informing the policy-making process with data obtained directly from teenagers. The project involved 620 students from 36 classes distributed in 16 schools around the city. TeenCarTo's first run was from October to December 2014, in this period 2.473 entities were collected. Each student was required to add at least five places on FirstLife which had to be among the most meaningful to them, triggering descriptions about their daily life and experiences in the city.

Thanks to TeenCarTo project we had the chance to experiment on different important aspects:

- multiple descriptions of common entities
- multi-dimensional categorizations
- the difference between describing and mapping

During the project, it turned out that many students shared common habits and decided to describe the very same places. FirstLife platform allowed the teenagers to easily add one description on top of the others when linked to the same georeferenced entity. The FirstLife's users indeed, rather than editing the same entity and modifying a previous description, can add multiple descriptions, additional pieces of information expressing different viewpoints, which are independent from each other. This approach allowed a semantically richer and multifaceted description of each entity, which can be differently presented by the students on the basis of their own experiences and opinions.

Furthermore, we introduced a multidimensional category system in order to provide three different map themes concerning: the place's function, the possible presence

of ongoing urban transformations, and whether the place is perceived by the teenager as a resource or as a problem.

The students were not simply requested to map their favorite places, they also needed to identify and classify what they wanted to map, and to write an expressive and relevant description of their experience related to those places. Some students found it difficult to point a place in the right position, others had to think about categories for the very first time. They understood that being able to identify an important place does not always mean to know why the place is important or how to express these reasons.

TeenCarTo was the project that highlighted the need of multi-dimensional categories to enrich how reality is represented and can be explored on the map.

2) MiraMap

The project was run in the Mirafiori District in Turin (Italy), a neighborhood which is characterized by several undergoing urban transformations. The objective of MiraMap [58] is to facilitate communication and management between citizens and administration in reporting issues and claims but also in submitting proposals. In order to achieve those results, we combined FirstLife with an open source Business Process Management System for easing the handling of claims and proposals. The research process involved an interdisciplinary team, composed of architects, computer scientists, engineers, geographers, and legal experts, with the direct participation of local administrators and citizens. The challenge was to convey in a third party platform a public service keeping the social features and the institutional aura at the same time, as well as conveying the right use of the platform to both sides.

In MiraMap, FirstLife works as the entry point for tickets about local issues; those tickets are being officially received triggering the internal protocols of the district offices. All the communications between users and the authority is public and visible through the platform along with the current status of the ticket. The tickets are shared entities among citizens and the local authority. Users can backup tickets through the subscription mechanism and post comments and pictures about the issue. On the other side, the communications from the local authority are posted in the same entity clearly showing what is actually going on.

The main project outcomes are: having created a ''smart'' methodology and tool, based on the use of ICT (Internet and mobile phones) to map city problems as well as to allow co-production of services among citizens and enhance the community participation and social inclusion; having allowed not only to identify and point out single interventions, but also to analyze phenomena at the urban scale; having built local capacities, stimulated participation and ownership; having enabled Local Authorities to access and use the data, to build and strengthen their accountability.

3) WeGovNow

WeGovNow [59], [60] is an EU funded project that aims to develop a fully-fledged OG system composed of volunteered geographic information functionalities intermingled with components allowing citizens to directly report issues [4], to discuss and vote on specific topics with a liquid democracy software [61] and to match offers and demand for collaboration and support.

The platform empowers citizens in their relationship with the local government: they can report problems and suggest improvements, discuss their relevance, explore ways to fix problems through collective action, find solutions to compensate for resource shortages, debate topics of strategic nature, and develop and vote upon concrete suggestions for local policy action.

FirstLife is one of the five components of the platform and in this context is used both as a crowdsourced map, to support citizens' knowledge and interest about the area they live in and what's happening there; and as an instrument to organize work groups, using Group entities, that operate on the territory, managing events, coordinating initiatives and effectively cooperating on a local scale. The integration between FirstLife and LiquidFeedback/ImproveMyCity is very tight and allows users to seamlessly move between the discussing/voting and reporting interfaces and FirstLife's map, fostering collaboration on a local scale.

The development of the platform finished in 2017, and during 2018 it is being set up in three different cities (the London Borough of Southwark, Turin and San Donà di Piave), where it will be applied on distinct use cases. These pilot outcomes will be thoroughly evaluated in terms of viability and sustainability, both with quantitative and qualitative measures (e.g. semi-structured interviews and automated usage tracking) by the end of the project - January 2019.

In San Donà the focus is on regeneration of urban spaces and the involvement of citizens in related initiatives through pre-existing associations - an interesting experiment was to train the local users to fruitfully use the platform: different platform components' teams gave lessons regarding the philosophy behind their instruments and the technical details to local students involved in a school-work trainership project. The students themselves will teach local associations owners and council employees how to use the platform, thus directly collaborating with their fellow citizens and at the same time completing their trainership focused on knowledge transmission, which is particularly interesting when directed from young adults to other age groups and involving new technologies.

C. ONGOING AND FUTURE PROJECTS

One of the new developments in progress is the possibility of adding personal points of view on single entities not only using text and images in the posts or comments, but also rating them along a certain set of parameters (i.e., overcrowding for public places or events, noise levels of places, quantity of

litter in public parks, etc.), or adding punctual information about how single users interacted with the entities in real life via dropdown menus (i.e. having lunch or dinner in a given restaurant, amount of money spent for eating there, etc.). The requested rating or fields can be easily defined, like other branch specific settings, with a configuration file, and thus can be easily tailored to specific project aims - the need for this feature arose to allow, on the one hand, users with autism [62] to evaluate places according to some relevant criteria and, on the other hand, to collect information about eating habits of University students. The ratings collected from users with autism are being gathered to identify the most suitable locations to spend time in a city and, using the georeferencing features of FirstLife, to develop an app that is able to suggest ''best routes'' in a city to a newcomer, by exploiting the opinions of users that are expected to share with her a set of environmental sensitivities. This feature allows for more quantitative points of views to be collected and also represented in a summarized way to the users (the average for numeric ratings, pie charts for dropdown menus), enhancing, on the one hand, the information that users can discover using the system and, on the other hand, allowing focused data analyses in different contexts. By and large, the possibility of personalizing the points of view on single entities may enhance the user's experience of the city, as diverse categories of individuals may be provided with certain information in a specific way, that may satisfy their idiosyncratic needs.

We are working on a completely new user interface to address some of the interaction issues that arose during the experimentation; we are furthermore planning to add a recommender system to enrich the user experience in different phases, for example suggesting entities related to issues that are of relevance for the places the users visit more frequently.

By integrating the features described above, FirstLife will be used as a platform for participatory planning and collective monitoring of processes, within a project aiming to re-think the home hospital care models of the planned new two major health centers in Turin and Novara. This means a complex plan of urban relocation and functional reorganization, which can benefit from an integrated tool for collaborative management of information and monitoring data coming from both professionals and citizens. The platform will ensure the transparency and social acceptability of the process, allowing the involvement of many stakeholders of the territories, and the collection (through public consultations) of data about both the local social fabric and the health services; these will be analyzed through Business Intelligence and Data Analytics tools, to support evidence-based decisions on the destination of the future structures. Starting from a shared representation of how the actors interact in the territory surrounding and inside the hospital, the map sets the basis for an innovative management of the information fluxes across time, thus supporting the coordination efforts. The platform overcomes the limits of rendering models, which do not track relationships between actors and Web-GIS, which focus on territories with limited interactions with the public. The ongoing, transparent and collective exchange of information can facilitate informed decision and the reconciliation of different positions, giving each of the actors responsibility as facilitator, and enabling a shift from citizens consultation to active collaboration of actors towards a shared goal on the common territory.

VII. CONCLUSIONS

In this paper we presented a civic social network called FirstLife which combines social networking technologies with VGI. Comparing to existing systems based on geographic crowdsourced information we proposed a new digital framework to support coordination, cooperation and collaboration among citizens and with public institutions at a local scale.

We described the participatory approach which has been experimented for requirements elicitation and to guide the model design. The platform development is an ongoing process based on iterative refinements adapting the platform to users' needs in different contexts. To this aim, living labs have been organized. The platform's model resulted in a representation of complex entities mirroring real world dynamics and allowing several stakeholders' interactions.

Finally, experimentation is presented highlighting the platform's flexibility to different working contexts.

Overall, our proposal tries to offer the following contributions: 1) advancing current VGI systems with an underlying conceptual model and new functionalities centered on supporting coordination, cooperation and collaborative works; 2) providing a CSCW system with a map-based visualization to focus on and connect users with the urban scale. Wider social implications of this proposal may be represented by the possibility of making our urban environments more accessible to disempowered categories of users (e.g., with disabilities), by providing them with tailored information and tools for carrying out their initiatives; as well as by the opportunity for enabling situational awareness and rapid collective actions during e.g., crisis events.

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