Visualization Techniques to Empower Communities of Volunteers in Emergency Management

Sergio Herranz, Rosa Romero-Gómez, Paloma Díaz
DEI Lab – Computer Science Department
Universidad Carlos III de Madrid
Leganés, Madrid, Spain
{sherranz, rmromero, pdp}@inf.uc3m.es

Abstract—Information and communication technologies might help to emergency communities of volunteers to both empower community participation and improve their capacity to respond to unexpected events. However, designing technology to support these benefits places unique visualization challenges that go beyond the current state of research on public participation tools and related technologies. Empowering these communities requires developing representations that enable collaborative reflection, promote mutual visibility of volunteers’ efforts and sustain a shared view of the community. Similarly, it is necessary to create visualization methods that facilitate sense making of large, simultaneous and distributed pieces of heterogeneous information of different priority levels and with different levels of credibility. Accordingly, this paper analyzes these challenges and proposes a multi-view, multi-abstraction-level visualization approach to address them. In particular, it combines time-oriented visualizations, space-filling visualization techniques, interaction mechanisms and coordinated maps to support community participation as well as collaborative and individual sense making. The application of these visualization techniques is discussed through the development of a set of design prototypes.

Citizen participation; communities of volunteers; emergency management; sense making; visualization techniques

I. INTRODUCTION

The field of emergency management has been evolving over time to adapt to the complexity of disasters associated to modern societies. Originally, emergency management was based on rigid and bureaucratic command-and-control approaches in which responsibilities were exclusive of experts and governmental actors. Nowadays, emergency management is gradually moving from this traditional model to a more collaborative and social one that recognizes the importance of the participation of other actors such as non-profit organizations, volunteer groups or even citizens [32]. In this context, communities of volunteers are considered a fundamental asset to face crisis situations within this field [4]. Communities of volunteers are groups of individuals who altruistically collaborate with official emergency organisms and corps and who have accredited skills and knowledge valuable in specific crisis situations.

Current technological advances on mobile and social computing might empower these communities of volunteers to participate more actively and to receive additional information from external sources of data [19]. Communities are not isolated structures [33]; they need to complement their perspective with other sources and including citizen-generated data in their perspective might contribute to take profit from the potential of citizens as natural information seekers [24]. For this to be possible, some design challenges need to be addressed, which can be classified into: (1) community issues – emergency communities are complex social structures that require to deal with difficult concepts such as membership [23], collaborative discussions [30], or awareness [10]; and (2) sense making issues – emergency communities need to make sense of the emergency information to make well informed decisions. It brings to the forefront the need of enable collective reflection, promote mutual visibility of volunteers’ efforts, and sustain a shared view of the community. It also highlights the necessity of integrating multiple, large-scale data, including citizen-generated data as well as simultaneous pieces of information of different priority levels and at various geographic locations. Furthermore, each piece of information may come from many different roles of citizens according to their level of credibility [12].

To address these challenges, this paper presents a multi-view, multi-abstraction-level visualization approach aimed at assisting both community participation and sense making activities. We utilize visualization because it can provide varied and richer ways to perceive the community activity and, contribute to improve emergency awareness. In particular, this approach combines time-oriented visualizations, space-filling visualization techniques, interaction mechanisms, and coordinated maps as main visualization mechanisms. This approach provides a flexible, interactive way for volunteers to explore both community and emergency information.

The remaining of the paper is structured as follows. Next section first provides an overview of the areas of communities of volunteers, citizen participation, and information visualization. Then, it discusses related work on public participation tools across application domains. Section four analyzes these design challenges and proposes different visualization techniques to address them. It illustrates the application of these techniques through a set of design prototypes. It also presents a usage scenario of these prototypes.
and the insights that they can afford. Finally, some conclusions are drawn.

II. BACKGROUND

As it has been previously identified, the design of technologies that assist community activities involves design challenges related to both community features and citizen participation. Accordingly, this section first reviews literature on communities and citizen participation in emergency management. Secondly, it examines the role of visualization as a potential tool to support community participation and sense making.

A. Communities: a Structure to Empower Citizen Participation

A community is defined as a group of people who share common concerns, interest or practices, and who interact frequently becoming socially interdependent [6]. Community members evolve into a social unity whose goals rely on the cooperation with other members. A community emerges around a communal identity that includes “common values, norms, rules, goals, and so on” [17]. Furthermore, community members need to share a feeling of membership and attachment with the community and its identity. This is what is being conceptualized as “sense of community” [23], which has a positive influence in volunteer’s involvement and participation [7]. The sense of community defines a community using four dimensions:

• Membership. This dimension refers to the feeling of identification with the community. It involves boundaries that determine who is part of the community.

• Influence. This bidirectional dimension is defined as the sense of having influence or being influence by the community.

• Integration and fulfillment of needs. This dimension corresponds to the feelings of being supported by members of the community while also supporting them.

• Shared emotional connections. This dimension refers to the interactions between community members that conform a shared history in the community [23]. This history is considered an important source of cohesion for community members.

Similarly, Carroll and Rosson [10] propose another conceptual model of community composed by three facets: identity, participation and awareness, and support networks. Identity is built through shared experiences and it enables the feeling of membership and belonging to a community. Participation and awareness transform identity into visible activities. Staying aware of community activity is considered also a form of participation. Finally, participation and awareness requires multiples forms of supporting network in which members with different roles can interact between them. Due to all these complicated social and psychological facets, building communities a non-trivial issue.

Communities are considered powerful structures to channel and empower citizen participation [15]. They provide spaces for interaction that contribute to develop a sense of purpose and belonging, a feeling of being part of something [23]. In this way, citizens could feel that their participation counts and has an influence beyond their role of information seekers, moving upwards in the participation ladder [2]. This helps thus to foster community participation [7] and transforms isolated citizens into work partners that exert a real participation.

B. Citizen Participation in Emergency Management

Citizens from local and surrounding areas are the first responders in case of an emergency warning or disaster [24]. Participation of citizens in these situations can take a variety of forms such as providing first relief, helping in searching and rescuing activities, etc. Citizens, who have been characterized as information seekers [24], are a valuable source of information [25], particularly now that social networks and mobile computing allow them to capture and disseminate information quicker and broader than ever.

However, citizens are a heterogeneous crowd composed by people with diverse skills and capabilities to inform about and evaluate the situation. Keeping with this reality, a model of ecology of participants in emergencies has been defined in [12] as the basis to design technologies adapted to different roles of participation. This model conceptualizes citizen participants in five different roles: citizen, sensor, trusted sensor, node, and agent. As an example of this conceptualization, while a citizen who sends a tweet on a warning is considered a sensor, a volunteer enrolled in an organization, who has accredited experience, is considered a trusted sensor. This latter means that his data can be directly processed because is reliable from the point of view of the authorities in charge of the emergency management protocol.

C. Visualization for Sense Making and Community Participation

Visualization is formally defined as “a graphical representation of data or concepts, which is either an internal construct of the mind or an external artifact supporting decision-making” [31]. Considering its external nature, DiBiase [13] distinguished two purposes of visualization: assisting sense making in the private domain and facilitating visual communication in the public domain. Sense making is in turn defined as “the cyclical process in which humans collect information, examine, organize and categorize that information, isolate dimensions of interest, and use the results to solve problems, make decisions, take action, or communicate findings” [21]. Visual communication has been defined as “the conveyance of ideas and information in forms that can be read or looked upon” [29].

He also pinpointed the important role of visualization tools as a medium to enhance group communication. Studies in collaborative intelligent analysis have shown that visualization techniques can help people to rapidly comprehend complexly tangled information in emergency situations. More recently, Convertino et al. [11], have studied that these techniques can increase the quality of the group reasoning by reducing
judgment bias in collaborative conditions. The use of visualization can influence the level of participation of the members and the information sharing process during community decision-making [35]. As an example, shared visualizations can help working groups to communicate more effectively by externalizing the communication process [14]. We posit that proper visualization techniques can be used to enhance the capabilities of communities of volunteers in emergency management. On the one hand, they can provide varied and richer ways to perceive the community activity and, on the other, they can contribute to improve emergency awareness particularly when heterogeneous and multiple sources of information are combined.

III. RELATED WORK

Emergency management is not the only application domain in which visualization mechanisms have been used to empower public participation. This section reviews this application not only within the emergency management domain but also within other application domains such as policy-making, law or education.

Due to their capability to facilitate complex human activities involving the use and organization of geo-spatial information, geo-visualization tools have been the most applied instruments for representing citizen information in emergency management. This application has lead to the concept of Crisis Mapping [22], which can be defined as "the display and analysis of data during a crisis, usually a natural disaster or social/political conflict". Examples of crisis mapping tools can be found in the most phases of emergency management such as The Wired	extsuperscript{1} for the preparedness phase, Usahidi Project	extsuperscript{2} as a very well known tool for the response phase, or OCHA	extsuperscript{3} (Office for the Coordination of Humanitarian Affairs) for the recuperation stage. Fig. 1 shows the Usahidi map used during the Haiti Earthquake in 2010. One benefit of these crisis-mapping tools is that they can increase the situation awareness of a crisis situation, since they display interactive maps of public information reported by citizens either remotely or from the site of the crisis. However, as a downside, they do not make any distinction between roles of citizens according to their level of credibility.

CSAV (Computer-supported Argument Visualization) mechanisms have been used successfully in the domains of policy-making, law or education. They can be defined as “visualization applications for helping people to participate in various kind of goal-directed dialogues in which arguments are exchanged” [1]. Well-known examples of CSAV tools are Carneades [16] or Araucaria [27], which aim to help both citizens and government officials take part more effectively in dialogues for assessing claims. Fig. 2 shows an example of an argument displayed in Carneades.

The above summary shows that although visualization is regarded as a powerful tool for empowering citizen participation, most existing tools mainly focus on displaying citizen information in a comprehensible way. There is still very limited support for both encouraging the involvement of citizens through communities and considering the heterogeneous nature of citizen’s information. Moreover, these tools still have limitations when high volumes of information are considered. For example, in the case of CSAV tools, they face overlapping issues if large-scale argumentation maps need to be displayed.

IV. ASSISTING COMMUNITIES OF VOLUNTEERS THROUGH VISUALIZATION

Keeping with the potential of visualization to support sense making and community participation, this section proposes a visualization approach to enhance the capabilities of communities of volunteers through visualization mechanisms. The scenario to illustrate this approach is the participation of communities of volunteers in early warning activities that is a typical contribution in this domain. Communities of volunteers make up a monitoring network that tracks emergency warnings declared by emergency managers in an early stage. Volunteers act then as human sensors, collecting and sharing information about their evolution, the so-called Volunteered Geographic Information (VGI). As communities, volunteers can also collectively reflect upon this information, thus emerging a

\[\text{Figure 1. The Usahidi map of Port-au-Prince during the Haiti Earthquake in 2010}\]

\[\text{Figure 2. Example of an argument displayed in Carneades}\]

\textsuperscript{1} The Wire, http://www.depiction.com/
\textsuperscript{2} Usahidi Project , http://www.usahidi.com/
\textsuperscript{3} OCHA, http://www.unocha.org/
collective picture of the warning that will be analyzed by emergency managers and corps to understand the situation and give a better response. Examples of this type of communities are the “Australian Early Warning Network” (EWN), the “Amateur Radio Emergency Service”, or the Spanish “REMER” (Red Radio de Emergencias).

The following subsections describe both the core design challenges to be addressed, and the visualization and interaction techniques used by our visualization approach through design prototypes implementation. Finally, a usage scenario of how these prototypes might be used to assist volunteers in early warning activities is provided.

A. Design Challenges

Based on the previous characterization of both citizen participation and communities in emergency management, a set of design challenges can be identified. These challenges can be classified into two main categories: community issues and sense-making issues.

Regarding community issues, the following design challenges have been determined analyzing the literature and studying communities of volunteers in Spain [20].

DC1. Shared view of the community history. Sharing a history is a fundamental source of cohesion for community members. Indeed, being aware of the activities performed in the community space is also a form of participation. For this reason, it is important to provide a comprehensive and understandable view of the community that allows members to navigate across its history over time.

DC2. Community reflection. Communities are social structures that need to collectively reflect upon shared ideas, resources or situations. Reflection involves participating in the community discourse not just by contributing but also by commenting or evaluating existing contributions. Therefore, supporting community work should assist the collaborative exchange of information and facilitate collective reflection.

DC3. Mutual visibility. A community achieves real participation when member’s contributions become visible and thus are taken into account. Making clearly visible this investment contributes to increase engagement and generate reliability. Accordingly, it is required to ensure visibility of volunteer’s participation and investment within the community.

The design challenges regarding sense-making issues are the following.

DC4. Scalability. The volume of community and citizen participation can vary across crisis situations: the numbers of tweets published, the number of messages sent through smartphones, etc. Therefore, visual representations for community information are required to scale from low volumes of information to very high ones.

DC5. Role distinction. People with diverse skills and capabilities compose the crowd of citizens who can provide different types of information through different technological platforms and with different level of credibility. Thus, it is necessary to allow the distinction of information across roles of participants.

DC6. Spatio-temporal interrelationships. Community volunteers need to track emergency warnings and foresee their evolution across both time and geographical locations in order to support a better response to a situation. Accordingly, enriching community information with citizen participation should allow extracting spatio-temporal interrelationships between these two sources of information.

DC7. Details-on-demand. Not all emergencies require the same degree of response or attention, and each incident should be evaluated on a case-by-case basis. Therefore, it is required to provide flexible navigation and interaction to volunteers across information.

B. Design Prototypes

The following subsections describe the implications of our visualization approach in terms of visualization techniques according to the design challenges previously defined (DC1 to DC7), grouped in community issues and sense-making issues. In order to better illustrate our approach, a set of design prototypes was implemented using WPF 4 technology (Windows Presentation Foundation).

1) Supporting Community Issues

In order to support community issues, it is required that volunteers can access and collective reflect upon the information and items handled at the community scope. As shown the design prototype of Fig. 3, with the purpose of providing a shared view of the community history (DC1), an interactive-annotated timeline is proposed. Through the use of this technique, community volunteers can navigate among different records that describe the community activity across time, therefore assisting a temporal understanding of the community activity. These records are represented as labels. Trying to facilitate distinction across records, each of these labels is framed with different colors according to the nature of the record including warnings, events, resources, discussions, etc. Hovering the mouse over a label provides an extended summary of the most interesting information about the record. By clicking on it, a volunteer can access to the entire information about the record. In this way, community volunteers can progressively narrowing down the information and focusing on those records of interest.

Figure 3. Interactive-annotated timeline for assisting community history

Community reflection (DC2) must allow volunteers to initiate topics for collective discussion. This is mainly supported by a combination of diverse visualization and interaction techniques. First of all, volunteers can classify initiated discussions by using tagging mechanisms. These discussions are then displayed in a treemap-based visualization [34] in order to easily identify which of them are having more impact on the community (see Fig. 4). This treemap can be also adjusted by using direct dynamic filtering controls in order to allow determining the discussion topics of interest according to the number of discussions topics classified under such tag. Each tag is then divided in smaller rectangles, which represent the discussion topics, sized according to the number of comments associated to the discussion. Once a discussion is selected, all the comments of this discussion topic are displayed in detail on a list view. In this view, volunteers can explore these comments and contribute not only by sending multimedia or textual comments but also by rating existing contributions. This rating mechanism will help to identify relevant contributions [8] and promote a sense of efficacy [26].

In this view, volunteers can explore these comments and contribute not only by sending multimedia or textual comments but also by rating existing contributions. This rating mechanism will help to identify relevant contributions [8] and promote a sense of efficacy [26].

Finally, supporting mutual visibility (DC3) involves making visible member’s identity for the community. It is supported by a design prototype divided into two views: a general list of members and a detailed profile area. The list of members goes over the community members by displaying his name, last personal state, and an individual performance bar (see Fig. 5). This bar represents a summary of the quantity and quality of member contributions based on the collective rating of his community partners. The length of the bar depicts the quantity of contributions of each member, while the color indicates the quality of these contributions. More specifically, the green color represents the proportion of contributions rated mostly positively; the red color encodes those contributions rated mostly negatively; and the white color those contributions that cannot be classified because either there is not a minimum agreement with their quality or they have been not rated yet by sufficient number of members. By clicking on a particular member on the general list, the detailed profile area displays all the information related to the selected member. Content of these profiles is grouped into personal information such as name, age or interests; professional information including experience, skills, and background; and community information such as community investment and trajectory.

2) Supporting Sense-making

In order to achieve a better understanding of the emergencies tracked by the community, volunteers can take advantage of the information provided not only by other volunteers but also by citizens.

Figure 4. Treemap-based visualization for community reflection

![Treemap-based visualization for community reflection](image)

Figure 5. Individual performance bar for mutual visibility

![Individual performance bar for mutual visibility](image)
Aiming at assisting this purpose a design prototype have been developed. As shown in Fig. 6, it is divided into two main views: Overview (framed in purple), and Detail (framed in orange). Overview and detail interfaces have been recognized as effective for coping with scale and complexity (DC4). They allow the user to explore the content methodically, jump around, compare, and contrast [9]. Following paragraphs describe the main constituents of these two views.

The Overview view provides an overall representation of the geographical distribution of warnings and responses provided by volunteers and citizens, as well as their evolution in time (DC6). In particular, this information is provided by means of a combination of a variety of visualization and interaction techniques. A geographical map displays warnings and responses in their geographical position. As it was mentioned before (see Section III), geographical maps facilitate complex human activities involving the use and organization of geo-spatial information. In this geographical map, warnings declared by official agencies are encoded as areas. Responses to these warnings are represented in the map making use of different visual marks to distinguish between roles of citizens including icons for volunteers’ responses and colored circles for citizen information (DC5). For volunteers’ responses, it also uses a three-color scale for encoding different levels of priority according to damages. Three or four priority levels are generally recommended [28]. Using too many priority levels, it might lead to situations where higher-priority problems could be delayed too long. This color scale allows assessing response priorities, and therefore developing a better coordination of resources. In particular, it applies red for the highest level of priority, orange for the middle level, and yellow for the lowest one. For citizens’ responses, blue circles are used for encoding citizen information reported through mobile applications such as SafetyGPS5. Green circles are used for citizen information reported from social networks such as Twitter or Facebook. This map also provides a set of layers that organizes the previous information in categories and supplies additional information (DC7). These layers thus can be turn on and off by interest and are divided into two main groups: community information, which classifies all the previous warnings and responses; and contextual information such as weather forecasting or traffic levels. Layering seeks to avoid overloading the available space on the map as well as the user’s cognitive abilities. Furthermore, aiming at avoiding overlapping issues to high volumes of simultaneous citizen information, it sets the size of circles to show the aggregate value of the citizen participation (DC4). Finally, a double time-slider is provided in this map in order to allow understanding the temporal evolution of warning and responses. To high volumes of community information, it allows to delimit the information range at will supports the experience of exploration (DC7).

The second graphical element is a heatmap-based table that shows an overview of the level of participation of both volunteers and citizens over time. In this table, higher levels of participation are represented by darker colors on each cell and lower levels of participation by lighter ones. It facilitates the visualization and comparison of participation at a certain time interval. It is also highly coordinated with the geographical map through both the double time-slider and brushing and linking mechanisms [5]. According to previous research in information visualization [3], showing several coordinated views provide useful high information density in context. In this way, it allows to extract spatio-temporal interrelationships between sources of information, without letting lose track of

---

the current position of the data (DC6). In particular, the horizontal axis represents a time interval, which can be adjusted by using the double time-slider. Consequently, the information displayed on both elements, the geographical map and the heatmap-based table will be the same. The vertical axis represents different roles of citizens including community volunteers and citizens reporting information through different platforms such as mobile applications or social networks. In order to keep consistent across views; the same previous colors are used in this visualization excluding for volunteers’ information, which is represented by a gray-scale to sum up the three levels of priority. Accordingly, icons and colored circles on the geographical map are clickable, which form dynamic queries whose matching set is immediately shown in the heatmap-based visualization. This heatmap-based visualization will be updated each time new relevant responses come.

In order to support a flexible navigation and interaction across information, the Detail area provides additional views, tightly coupled with the geographical map (DC7). According to the item selected through this map, a different detailed view is displayed (see Fig. 7 and 8). Therefore, this map can be characterized as a visual index to navigate through several levels of detail. Showing both several coordinated views and different levels of detail provide useful high information density in context. Each detailed view resides in a separate panel. In particular, a bar graph (shown at Fig. 7) is displayed if citizen information reported through applications, encoded as a blue circle, is selected. It shows comparisons among types of citizen responses. The horizontal axis shows a set of types of responses, which can inform about fires, accidents, need of emergency care and so on. The vertical axis represents the quantity of responses of each type. Selecting on a particular bar shows text lists of responses classified under the type selected. The rest of the bars are adjusted by substituting their color with a gray scale fill. It helps to focus on a subset of interest, while the general context of the data is preserved.

A streamline graph [18] is displayed (shown at the Detail view in Fig. 6) if citizen information provided from social networks, encoded as a green circle, is selected. This graph reveals the most relevant topics reported by citizens through social networks over time. The total participation is shown by the varying heights the stripes reach over time. The horizontal axis represents time and each stripe represents a relevant topic. The thickness of a stripe shows the number of messages related to this topic in the given time period. The color encodes a topic. When a stripe is selected, messages related to the topic are shown below the graph. As in the bar graph, the rest of the stripes are adjusted by substituting their color with a gray scale fill.

Finally, if a specific community volunteer response, encoded as a colored icon, is selected, it displays a textual view of the response information (shown at Fig. 8). In particular, it includes a summary of the respondent, textual and multimedia information related to the response, rating information from other volunteers, and the set of comments sent by other members. Both rating information and comments pursue generating reliability on the response.

C. Usage Scenario

Consider the case of a community of volunteers tracking a heavy rain emergency warning declared for the Madrid area.
Given these circumstances, a volunteer would like to understand relevant information to the situation in order to both make well-informed decisions and inform authorities facilitating a better response.

The volunteer begins by navigating through the interactive-annotated timeline (see Fig. 9). Upon visual inspection, he notices that a warning has been active for the past few days. By hovering the label corresponding to the warning record, he can characterize it as a high-level priority one. Similarly, he can perceive that there have been several recent contributions to this warning by other volunteers of the community. For this reason, he decides to get further information about both its spatial and temporal context and the magnitude of the situation. With this purpose, he clicks on such label in order to display a geographical map that represents warnings and responses in their geographical position. As mentioned before, a warning is represented in the map as a circular area. Within this area, he can explore both community responses, displayed as colored icons, and external citizen-generated information, displayed as colored circles (see Fig. 10). He also can make use of the double time-slider in order to understand their temporal evolution. In particular, the time period of interest is configured to the last twelve hours. Thanks to this mechanism, he can understand that both other volunteers and several citizens at Madrid center have reported several responses related to the warning. Moreover, given the coordination between the time slider and the heatmap-based table, he is able to perceive that participation levels have been higher in the last two hours. In particular, he can characterize social networks as the most active channel of participation (see Fig. 11).

However, prior to analyze these high volumes of information coming from social networks, he decides to explore the information provided by the community volunteers. In contrast to the information provided by social information coming from social networks, these responses can be characterized as more structured and reliable information. For this end, he updates the time-slider period from the last twelve hours to the last two hours. Similarly, he makes use of the map layers in order to specify the display on the map of just volunteers’ responses (see Fig. 12). Based on this customized view of the warning-related information, he can perceive that during this two-hours period most of responses have been reported from Madrid southwest area. In particular, he identifies a set of high-level priority responses referred to personal injuries. He decides consequently to focus on one of them by clicking on the corresponding icon. As a result, a more detailed view is displayed, which shows a summary of the respondent’s profile, a textual and multimedia description of the report information, and a set of comments provided by other members. The textual description explains that several pieces of a building cornice fell down, causing injuries to citizens passing by the building. The multimedia description includes different pictures that display the current state of the building. Aiming at knowing the reliability of the respondent, he decides to access to the respondent’s profile. According to the individual performance bar (see Fig. 13), it seems that most of the contributions of this respondent have been rated positively. Consequently, the volunteer can characterize this response as a reliable piece of information. Similarly, by exploring the comments associated to this response, he perceives that some members have been discussing about the number of injured citizens provoked by this event. According to these comments, the number of slightly injured citizens varies from ten to fifteen citizens and none of them is severely injured. He therefore gets a better idea of the seriousness of this situation. Nevertheless, given the previously identified high-level of citizen participation through social networks, he wants to explore further such information and identify if there are relationships with the volunteers’ responses.
With this goal in mind, the volunteer makes use again of the map layers in order to specify the addition to the map of citizen-generated information. In this new view of the map, he can observe that there exists a big green circle, located at southwest Madrid, which represents a high volume of citizen-generated messages. Given the geographical proximity to the previous high-level priority volunteers’ responses, he clicks on this circle in order to get a more detailed view. This action displays a streamline graph that shows the discussion over time for the topics most relevant associated with the warning (see Fig. 14). By clicking on the widest stream of this graph, encoded in green and tagged as “power outages”, he can explore the messages and multimedia content associated to this topic. After exploring them, he discovers that the cornice falling has lead to electrical damages in such street. The risks associated to an extended loss of electrical power in that area makes this information particularly relevant to be communicated to authorities.

V. CONCLUSIONS

Visualization has proven its worth over time as a relevant instrument to assist sense making and enhance group activities. In keeping with this importance, this paper envisions a visualization approach aimed at empowering communities of volunteers focused on early warning activities. The techniques here proposed seek to enhance community participation and facilitates sense making of emergency situations by integrating external citizen information. The design prototypes show how using elements such as space-filling or interactive time-oriented techniques could assist collective reflection and community visibility. In terms of facilitating sense making, this solution must deal with large pieces of information from a variety of sources with different levels of credibility. The proposed visual approach copes with these issues by utilizing coordinated maps and different levels of information abstraction. It also provides a number of design ideas that could be employed by others working on similar problems or even in different domains containing similar design issues.

Further work will be focused on evaluating the design prototypes proposed in this paper. However, it has to be considered that technologies for EM cannot be tested in complex real situations where agencies and corps are not willing to try new technologies but to be as efficient as possible applying the procedures they are familiar with. For that reason, an evaluation under controlled settings could prove valuable. Volunteers of communities supporting early warning activities could interact with the design prototypes on a set of pre-defined and realistic scenarios. Afterwards, we would like to explore their perception about the usability of the design prototypes as well as the usefulness as an instrument to support community activities.

ACKNOWLEDGMENT

This work is supported by the project emerCien grant funded by the Spanish Ministry of Economy and Competitivity (TIN2012-09687).

REFERENCES