Using Video Prototyping as a Means to Involve Crisis Communication Personnel in the Design Process: Innovating Crisis Management by Creating a Social Media Awareness Tool

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Abstract. Social media is increasingly used for all kinds of everyday communication, with vast amounts of user-generated content being continuously generated and published. The data provides a new form of information source that can be exploited for obtaining additional knowledge regarding a subset of the population. Although it might be difficult to organize and assess individual text fragments, valuable insights contributing to the overall situational awareness can also be gained through acquiring social media texts and analyzing statistical properties in the data in near real-time. One such avenue of approach which is currently being developed is to analyze the text content linguistically and extract measures regarding the overall feelings and attitudes that people express in relation to an ongoing crisis. To make use of this kind of new information requires the algorithms and the resulting statistics to be designed and presented according to operational crisis management needs. In this paper, we describe the involvement of crisis management stakeholders in a series of user-centered activities in order to understand the needs, and design a useful tool. In particular, video prototyping has been used as method for quickly capturing a first explicit design idea based on real life experience, that could later be used for further generalization and tool design.

1   Introduction

The overall objective of the EU research project Alert4All is to improve the effectiveness of alert and communication towards the population during crises. One component in the Alert4All vision is for the command and control (C2) personnel to be able to monitor social media to find out how people perceive the crisis and how they react to—or not react to—communicated alert messages. Hence, the aim of the Alert4All screening of new media (SNM) tool is to enhance situational awareness [3] among crisis management personnel with regard to public opinions and citizen alertness, based on on-line web content from Twitter, blogs, and other social media. [2,4,8] Monitoring public perception of communicated alert messages has been identified as a particularly important application area for the tool. In this way, new alert messages can be tailored based

on the estimated receiver susceptibility, i.e., how well previous messages have been received by a particular group of people. Designing such a tool is difficult since the relevant C2 stakeholders are busy people who are often on standby 24/7, and are also hesitant to alter daily procedures that are in operative use. This paper describes the activities with and the experiences from involving key personnel to bring about an informed user-centered design of the SNM tool.

The remainder of the paper is structured as follows. Section 2 provides a brief introduction to sentiment analysis and its potential for contributing to crisis management. Then, Section 3 outlines the research design, and Section 4 discusses the workshop series. Next, Section 5 summarizes the major findings from the workshop series, and Section 6 presents the resulting design considerations. Finally, Section 7 concludes the paper.

2   Social Media Awareness

Sentiment analysis, also referred to as opinion mining, has received much research attention during the last decade. Various interpretations of the term exist, but here we use the definition given by Liu [6] who considers sentiment analysis to be the computational study of opinions, sentiment, and emotions expressed in text. Affect analysis, also known as emotion classification, can be considered to be a sub-problem of the broader sentiment analysis problem [1].

Most research on sentiment analysis focuses on classifying a linguistic unit (such as a sentence or a document) as having a positive, negative, or neutral opinion towards the topic of the text. The topic is often assumed to be known in advance (e.g., by having a dataset containing only reviews of a particular movie), but it can also be part of the sentiment analysis task to find out toward which target or topic a specific sentiment is directed. Significantly less research exists on affect analysis, where one instead of only extracting a positive or negative sentiment (and potentially also the strength of the sentiment), also extracts people's emotions, such as "anger" or "fear." From this perspective, affect analysis can be considered a more fine-grained sentiment analysis task.

As a crisis management method, new media web screening is typically used for determining the state of various clusters of people. Here, state refers to, e.g., an emotional state that can be detected by analyzing new media text content linguistically with regard to sentiment, e.g., that persons are upset, happy, ignorant, etc. The relevant clusters of people refer to sections of the population that, in some relevant sense, resemble each other in some way, i.e., when disseminating a warning message one can use web screening to investigate whether tourists, elderly, immigrants, etc., have really been targeted by the message or if one should use another communication channel or perhaps reformulate the message in order to obtain better coverage or perhaps convey the information differently. Hence, social media awareness for crisis management requires a purposeful combination of data acquisition and sentiment analysis.

3   Methodology

To come up with an informed, useable, and useful design, it is important to acquire relevant information from the users of the intended design, whether it is a system or an interactive device. [9] The users are considered "domain experts," as they are experts at their own work in their own context, such as working as operators in a C2 center. That is not to say that they are the best to tell others about what they do, since there might be—and often is—a discrepancy between what you do and what you say you do. Therefore it is important to find methods to really make users give away what they actually know about their domain. It should also be noted that the acquirement of user input regarding a design serves to enrich the designers' and developers' design work, not to explicitly telling them what to do. That is, the users are experts within their domain, and the designers and developers are experts within their domain, i.e., design and development.

There are a variety of ways to get user input on a design, depending on the users and their context, the designers and their context, and in what stage a design is. In our case, the intended users of the SNM tool are commanders and operators working in C2 operating centers during a crisis. The users accessible for the Alert4All project and the workshop series are those that are part of the Alert4All advisory board which represents several European countries and C2 related professions. The SNM tool designers and developers also have different backgrounds from working in different European countries at organizations that differ regarding their focus on research vs. industry. Hence, when it comes to the people involved, language, culture and knowledge differences had to be taken into consideration when planning the user-centered activities. To make use of and draw upon the advisory board domain expertise, and to minimize the risk of language and cultural barriers to become problematic, the workshop was conducted using a variety of engaging design methods such as sticky note sessions, storyboarding, video prototyping, etc. These methods emphasize talking, writing, drawing, and filming as being different expressions that would help the participants to inform one another and also to inform the design itself. [5] In the end, the video prototyping activity turned out to be instrumental for the design end result, and will therefore be covered in more detail.

Video prototyping [7] as a concept can be described as a method to illustrate and communicate design ideas. The video prototype creation is done group wise as a mutual effort, which makes the video a shared artifact showing a joint design idea. It is based on real life stories and experiences told by the users, which makes the design idea explicit, focused, and detailed, rather than general. The explicitness is of importance to become concrete in the user-centered prototyping. Generalizations come later in the design process. Furthermore, it is a "quick and dirty" method, since you describe the design idea through a scenario using a storyboard and then shoot the video sequences in the order they should appear in the video. It means that there is no editing, which makes the video prototype rough as an instant sketch or prototype. Also, it is a useful method for "show and tell," since the design ideas are contextualized through the video and will appear the same over and over again. Hence, when watched together it

is always possible to criticize the design and give feedback. To summarize, one can think of video prototypes as user-generated contextualized design sketches, where design generalizations and realizations come later in a follow-up design process involving designers and developers.

4   Workshop Series

Throughout the duration of the Alert4All project, the advisory board has been brought together every tenth month at three occasions to provide feedback to the project, which has been utilized for obtaining three types of feedback: 1) a pre-study, 2) a design workshop, and 3) a validation exercise.

4.1   Pre-study

In June 2011, the advisory board met for the first time in Stockholm in Sweden in order to identify key factors to be considered for the design of a crisis management social media screening tool [8]. The participants' had different experiences from more or less similar events which were shared among them. Of particular interest was to discuss the assumptions underlying the Alert4All project as a whole, and the SNM tool in particular. Using a series of sticky note sessions, the participants confirmed that the ideas underlying the envisioned SNM tool is not something that they are used to or practicing in today's work, but that the SNM tool could probably be an important tool given the right type of implementation.

4.2   Design Workshop

In March 2012, a design workshop involving the advisory board was held in Munich in Germany in order to answer the following questions related to the further design of the SNM tool:

- What kinds of emotional states are relevant to consider operationally, i.e., what public emotions do the advisory board members consider to be interesting to know about in order to make an informed decision in a C2 situation?
- How would the advisory board members prefer to have the result of the screening presented?

Before the workshop, a two-page scenario description (based on the validated overall Alert4All scenario description) was compiled. The scenario contained a trigger incident and consequential incidents, namely a water reservoir dam wall breach followed by a leakage of a chemical substance, an explosion, fire, and finally infrastructure damage. The participants were asked to prepare by reading this scenario and envisioning the course of events that might emerge in such a situation.

After getting familiarized with each other, the workshop context, and the assumptions underlying the project in general, and the SNM tool in particular, the

first sticky note session was introduced. Divided into three groups, the participants were asked to individually think of and write down the types of emotional states that they considered relevant to consider operationally, i.e., what public emotions that would, in their opinion, be interesting to know about in order to make an informed decision in a C2 situation. Many notes were written and discussed in a clustering session where the group participants came to agree on a number of overall emotions/expressions that it would be interesting to know about. The group results were later synthesized into a smaller set of relevant emotions according to Section 5.

As a basis for the video prototyping activity, the advisory board then discussed how to make use of the envisioned awareness that could emerge as a result of using the SNM tool, i.e., they addressed questions regarding how one would want public perceptions to be presented in order for the information to be useful for making informed C2 decisions. A main conclusion from this discussion was that emergency management largely consists of performing actions in order to bring a situation into a, in some sense, better situation, i.e., what you want to have presented in the graphical user interface is how the situation is right now in terms of emotions relative to some attributes that you can actually do something about. For example, people might be anxious about the lack of food, which could be brought into a new situation by sending out information with regard to places to find food. Here, "anxiety" is the emotion to be looked for, and "food" is the attribute that the emotion targets. After that a new situation might occur where people are less anxious about the food, but perhaps have become angry about being neglected by politicians, which could potentially be targeted by sending out a second message, and so forth. As a consequence, quantification of the involved variables (emotions and attributes) was another main conclusion that the group saw as an important aspect that the SNM interface needs to take into account.

A most productive part of the workshop followed where the participants came up with how to incorporate the above described aspects (moving between states, and quantification) in a video prototype by making use of colored circles taking both dimensions (attribute vs. emotion) into account, showing a snapshot for each time slot to be considered. That is, the timeline was thought of as being discretized based on certain events such as when the crisis occurs, when a message has been sent out, etc. In Figure 1 six such snapshots can be seen. Here, the pink circles represent the attribute "environment," the orange circles represent the attribute "health," and so forth. Looking further, one can see that the public initially (i.e., after 10 and 20 minutes which is depicted in the first two snapshots) is concerned about the environment attribute, while later (i.e., after 30 and 60 minutes as depicted in the third and fourth snapshot) becomes angry regarding the environmental damages, and finally (i.e., after 2 and 3 hours according to the last two snapshots) becomes content with the development. Also, one can notice that the health attribute varies in size, indicating that the public's initial (after 10 minutes) fairly small concern successively develops into a more substantial concern after 30 minutes (the third snapshot). All in all, the result from the video
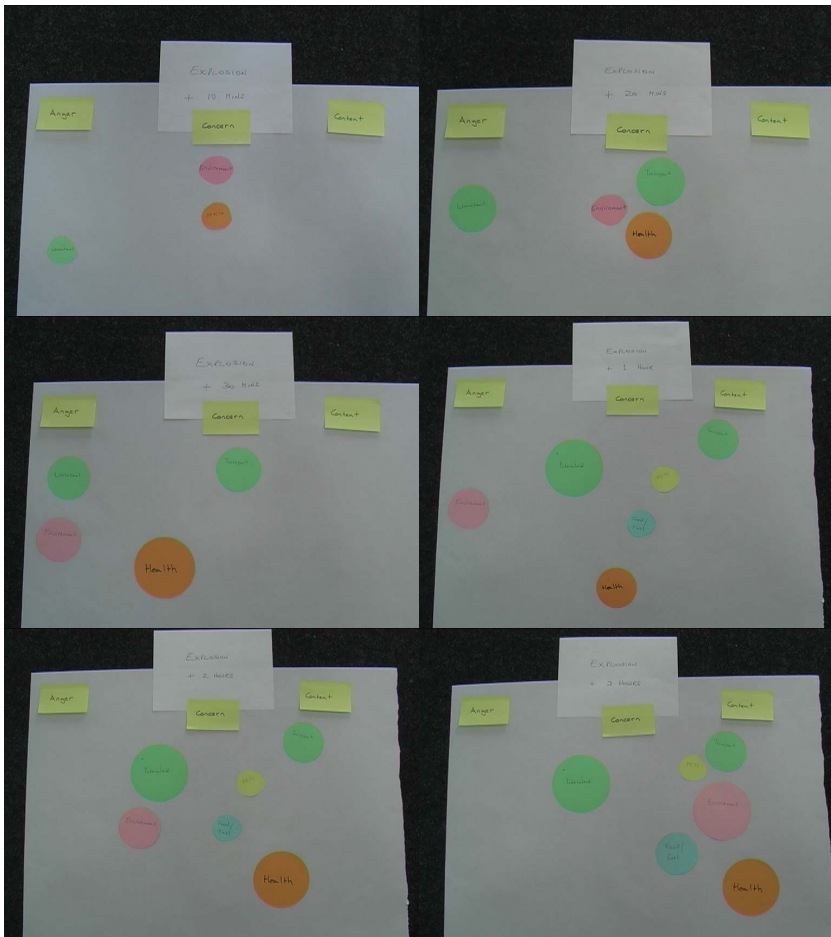
Fig. 1. Screenshots from the video prototype

prototyping activity was a success in that the participants became really involved in actually producing a video prototype describing aspects of the functionality and design that they agreed on being the most important to take into account for a future SNM tool to be used within emergency management.

4.3   Validation Exercise

Finally, in January 2013 the advisory board met for the third time in Bilbao in Spain in order to see and validate a first prototype system. Through a guided walk-through and the possibility to play around with the system, it turned out and was concluded that the many dimensions had to be visualized through several charts as can be seen in Figure 2 rather than trying to capture all relevant aspects in one single chart (as was the case in the shown prototype system).

# 5   Summary of Workshop Findings

Trying to summarize the main findings from the workshop series, it can be seen that the advisory board members agree on that there are recent events where the SNM would have been beneficial for obtaining better situation awareness (both the Utøya shootings and the London riots were mentioned). Despite this, there was initially skepticism in some of the workshop groups for making use of such tools during a crisis. Somewhat unexpectedly, no privacy considerations were mentioned, but instead the skepticism was based on the potential unreliability of the sources and the collected data ("we are acting on facts, not emotions"). Although the groups could see a clear potential for enhancing the situational awareness among crisis management staff with regard to public opinions and citizen alertness, this aspect was by some of the advisory board members seen as less interesting than the possibility to use the citizens as providers of information (e.g., by having them sending images or videos from the crisis area).

Moving on to the clusters of emotions, emotion states, or moods, the exact naming of the clusters differed amongst the workshop groups but common aspects and a clear theme could be recognized. One such finding is that one can look at many of the suggested emotion states as being somewhere on a continuous scale between a positive and a negative extreme. All groups have mentioned fear, anger, and anxiety as being important negative emotions (although the exact vocabulary has not been the same in all groups). In general, the negative emotions can be seen as more important than the positive ones from a crisis management perspective, but both aspects can be interesting for obtaining a better awareness of the overall picture, and to more clearly see how emotions have changed over time. There has also been a consensus on that active/action-oriented emotions is of larger concern than the passive ones, since the alert messages should be formed in a way that helps people take the correct action.

In terms of visualization, many of the groups have mentioned a need for an adaptive GUI that allows for various kinds of representations. The groups agreed on that it should be possible to see a quantification of emotional states within the posts, and also how these emotions vary over time (most importantly relative to the sent alert messages). Many of the advisory board members also expressed a request to see how the posts are distributed geographically. An interesting aspect that was mentioned in some of the groups is the wish to see the attribute or emotion target of the posts, i.e., to see not only the emotions but also the "theme" or target which the emotion is expressed towards (such as the "food situation"). Related to this is the need to be able to search for specific concepts or terms related to crises, such as "chemical" or "gas." Additionally, the groups wanted the ability to drill down to the actual posts, in order to see not only the overall picture, but also the individual posts.

6   Design Result

The SNM tool design consists of two parts: 1) a data acquisition part in which the user can decide what keywords, sources, etc., to use when retrieving posts
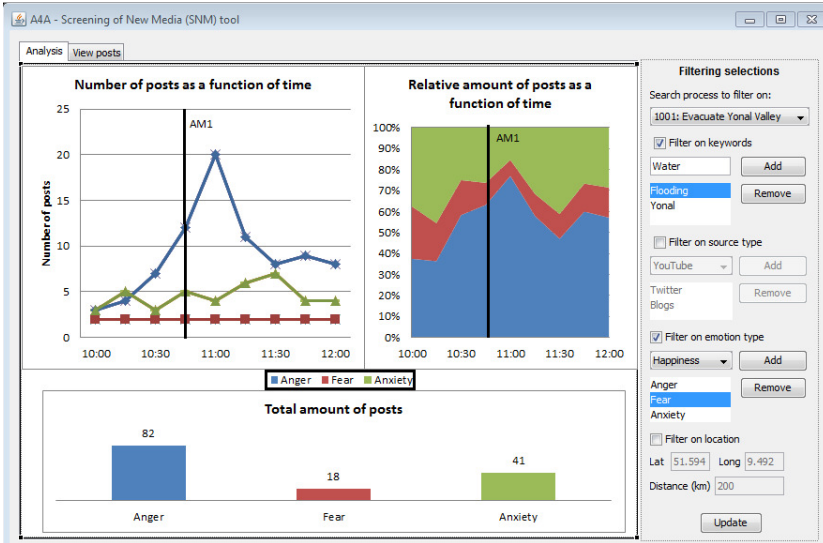
Fig. 2. The SNM data analysis tab gives the operator the possibility to visualize the screening results from a number of statistical viewpoints

related to a crisis, and 2) a data analysis part to be used for analyzing the retrieved posts to become aware of the development of the situation. In the following, we only consider the data analysis part of the tool, since this is the part of the tool that serves to enhance the users' situational awareness. The GUI for the data analysis part comprises an analysis tab according to Figure 2 and a view posts tab according to Figure 3. The main part of the data analysis tab consists of three charts which are meant to provide complementary views of the acquired data and citizens' reactions to communicated alert messages. The top left chart shows the emotional change in the absolute amount of collected posts over time, while the top right chart gives information about the relative change for the same time period. The bottom bar chart gives an aggregated view of the emotional distribution, summarized over the selected time period. As is shown to the right, a number of filtering selections are available for adjusting what data to display in the charts. Several search processes can be initiated during a crisis (e.g., keywords can be added as a new alert message is sent out), so the user has to select which search process to analyze. The user can also choose to only include collected posts containing special keywords of interest (e.g., flooding), or to include only some sources in the analysis. Finally, the user can select which emotions to include in the analysis and has the possibility to include only posts geo-positioned within a certain geographical area of interest. The communicated alert messages are displayed in the charts so that it becomes easy to see if there are emotional changes as reactions to communicated alert messages.
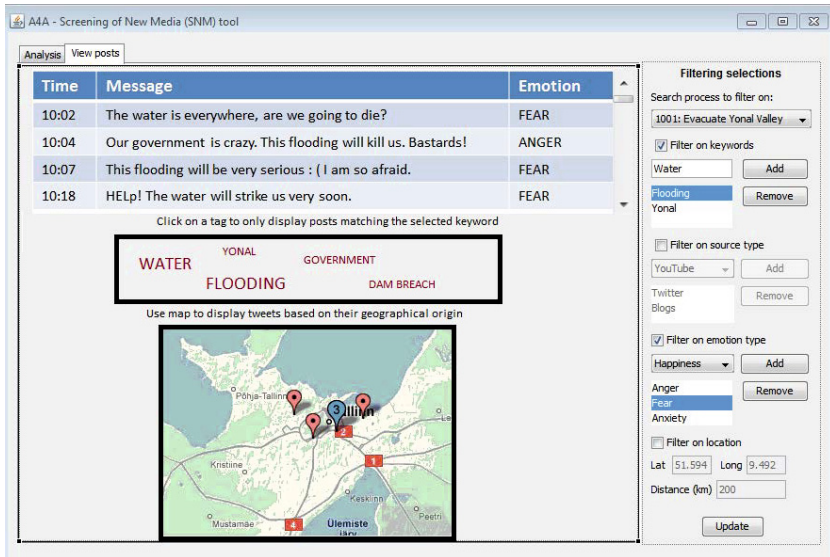
Fig. 3. The second tab gives the operator an alternative view to visualize the underlying data more focusing on the content of the underlying data/posts

The user can obtain an overall view of the situation by using the analysis tab, but in addition to this the user is also able to obtain a deeper understanding of peoples' emotions (e.g., what their emotion targets are). This kind of view is provided by switching to the view posts tab. In this tab, the user can see the collected posts matching the filtering selections and their associated emotions (as classified by an affect analysis algorithm). A tag cloud is displayed in the middle, showing the most frequently used terms within the posts, where the size of the words corresponds to their frequency. Finally, there is also a map in which the geo-positioned posts are aggregated based on their geographical position. By zooming into the map or clicking on a cluster, the individual posts are displayed.

7 Conclusions

The most important finding from the video prototyping activity is that crisis management largely concerns the work of exercising command and control in order to bring a crisis situation into some kind of better situation, and subsequently continuing to perform relevant actions until the crisis has ceased. It follows that situational awareness ought to be defined in terms of the parameters that define the situation, and that also can be affected in order to reach a more desirable situation. For the case of alert and communication, it turned out that the situation therefore needs to be quantified along three dimensions: time, emotions, and attributes. Especially important for the time dimension is

to distinguish between crisis situations so that the commander can see how, e.g., the broadcast of an alert message has brought the situation into a better situation. Regarding people's emotions, anger, fear, and positive emotions were deemed the most interesting to know about, i.e., it was deemed more interesting to know about different variations of the negative emotions whilst less interesting to distinguish between different variations of positive moods. Lastly, often an emergency manager wants to analyze the situation relative to a certain attribute such as food, health, etc. These three dimensions have been fundamental for the tool design which is currently being implemented and integrated in the overall Alert4All system.

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