LA-UR- 09-00363

Approved for public release;
distribution is unlimited.

Title:	Personalizing Situation Awareness
Author(s):	Linn Marks Collins James E. Powell Jorge H. Roman Mark L. B. Martinez Xiang Yao Ketan K. Mane
Intended for:	6th International Conference on Information Systems for Crisis Response and Management Special Session on HCI Design for Emergency Systems May 10-13, 2009 Göteborg, Sweden

Form 836 (7/06)

Personalizing Situation Awareness

Linn Marks Collins, James E. Powell, Jorge H. Roman,
Mark L.B. Martinez, Xiang Yao, and Ketan K. Mane
Los Alamos National Laboratory
Los Alamos, New Mexico USA 87545-1362
{linn, jepowell, jhr, mlbm, xiangyao@lanl.gov}, kmane@renci.org

ABSTRACT

Emergency responders need access to information but what counts as *actionable* information depends on their role, task, location, and other variables. For example, experts who have unique knowledge and experience and are called on to serve as scientific and technical responders, require correspondingly unique situation awareness in order to do their work. In our research-in-progress we leverage emerging and evolving web and digital library technologies to create personalized situation awareness tools that address the needs of these scientific and technical responders in real time, through focused information collection, extraction, integration, representation, and dissemination. We describe three personalized situation awareness tools in this paper: the Theme Awareness Tool (THEMAT), Social Awareness Tool (SAT), and Expertise Awareness Tool (EXPAT). The concepts and technologies we are developing in collaboration with experts apply to those who use the Web, in general, and offer an approach to the general issue of HCI design for emergencies.

Keywords

HCI for emergencies, human-computer interaction, emergency information systems, situation awareness, personalization.

INTRODUCTION

People responding to, victimized by, or otherwise involved in an emergency need access to actionable information. What counts as actionable depends on their role, tasks, location, and other individual variables. In the event of a natural disaster such as a forest fire or storm, for example, potential victims need to know when and how to evacuate. Often, phone calls are made using autodialers or police, sheriff, and fire department officials go door-to-door to alert people. Others who need personalized, actionable information in such natural disasters include (a) officials responsible for telling people to evacuate, who need to know the expected course of the forest fire or storm; (b) first responders, who need to know where and when to report; (c) public information officers responsible for communicating with the media, who need to know which facts they are allowed to release; (4) government officials such as governors in the US, who need to know whether precipitating events have occurred that would activate the local chapter of the National Guard, the Federal Emergency Management Agency (FEMA), and so on.

In the event of a global disaster such as a pandemic flu, all of the above will apply as well as more roles, tasks, and locations of concern, involving more local governments, more national governments, and more kinds of responders, including scientific, medical, and technical responders with rare but critical expertise. Each person will have a role to play, a task to perform, and a time and place to do so. The disaster may be global but each person's necessary and sufficient situation awareness will be specific and in some cases – e.g. the governor, the president, or the prime minister – unique.

In our work with scientific and technical responders in a national laboratory in the US, the people who are collaborating with us in designing our system (E-SOS: Emergency Situation Overview and Synthesis) are often called on to serve as responders because of their unique experience and expertise. These individuals require personalized situation awareness in order to do their work.

WEB TECHNOLOGIES ENABLING PERSONALIZATION

Significant research has been done in the area of situation awareness, some of it on individual cognitive and perceptual factors in system design (Endsley, 1995, 2000, 2004). Little research has been done in the area of personalizing situation awareness in an information-centric manner by using the Web. Yet the Web has created new opportunities for personalization by enabling the automatic "push and pull" of information via machine interfaces.

To take a simple example, the growth in the number of websites that offer RSS (Really Simple Syndication) and in the number of RSS aggregators bundled with web browsers makes it possible for users to create and receive personalized news feeds. With a few mouse clicks, they can synthesize national situation updates from the US Federal Emergency Management Agency (FEMA), press releases from the US Department of Homeland Security (DHS), and feeds from dozens of homeland security weblogs. Some 30 of the latter have been identified as noteworthy by the US Homeland Security Digital Library, including a biosecurity blog maintained by the Federation of American Scientists (FAS) and a superstrain blog maintained by a graduate student (http://www.hsdl.org/?homefront:blogsearch, 2008). As blogging tools have made it possible for citizen reporters, or "citizen sensors", to contribute first-hand reports of events – e.g. CNN's iReports – the content of many news feeds has, itself, become more personal.

Combining news feeds about homeland security from federal officials, professional societies, and individuals is an easy way to create personalized web feeds. It is possible to personalize feeds at an even finer grain – to add geographic personalization – by displaying items on a map to indicate information relevant to a particular location (Collins, Powell, Dunford, Mane, Martinez, 2008; Environmental Systems Research Institute, 2008).

Even finer-grained multi-dimensional personalization can be provided via awareness tools that leverage emerging and evolving web and digital library technologies. Efforts to further personalize web technologies could have a significant impact on the public in an emergency: a survey conducted after the southern California wildfires in 2007 found that 76% of the respondents used websites and 38% of the respondents used alternative news sources and individual blogs to find relevant information (Sutton, Palen, and Shklovski, 2008).

SITUATION AWARENESS TOOLS ENABLING PERSONALIZATION

In our research-in-progress we are building on these emerging and evolving technologies to create personalized situation awareness tools that address the needs of scientific and technical responders in real time through focused information collection, extraction, integration, representation, and dissemination. We are developing eight tools, three of which are described in this paper: the Theme Awareness Tool (THEMAT), Social Awareness Tool, and Expertise Awareness Tool (EXPAT).

Theme Awareness Tool (THEMAT)

The Theme Awareness Tool (THEMAT) extracts themes from text and creates knowledge signatures: a set of themes organized hierarchically that represent the important content in a news feed, blog post, or a scientific paper. The tool works proactively, so that as news feed are aggregated or blog posts are submitted, themes are extracted and knowledge signatures are created automatically. A taxonomy, or union of knowledge signatures for the set, is computed for each day, week, or other time interval of interest and displayed in columns, resulting in a Time Interval Comparison (TIC) that facilitates analysis of changes over time in a given information source.

Intersection of sets: 2009-01-09 06:00:00 to 2009-01-09 07:00:00 and 2009-01-09 07:00:00 to 2009-01-09 08:00:00	Intersection of sets: 2009-01-09 07:00:00 to 2009-01-09 08:00:00 and 2009-01-09 13:00:00 to 2009-01-09 14:00:00	Intersection of sets: 2009-01-09 13:00:00 to 2009-01-09 14:00:00 and 2009-01-09 14:00:00 to 2009-01-09 15:00:00
ATTACKS		
GAZA	GAZA	GAZA
ISRAELI		
ISRAEL		
OBAMA	OBAMA	OBAMA
POPULAR	POPULAR	
RESOLUTION	RESOLUTION	RESOLUTION
ROCKETS		
SECURITY		
UNITED_STATES		
VIDEO	VIDEO	VIDEO
	BUSINESS	BUSINESS
	BUSINESS_NEWS	BUSINESS_NEWS
	CAREERBUILDER	
	CEASEFIRE	CEASEFIRE
	CONGRESS	CONGRESS
	DISCLOSURE	DISCLOSURE
	FINANCE	FINANCE
	FUND	
	INDEX	INDEX
	ISRAEL_REBUFFS	ISRAEL_REBUFFS

Figure 1. Theme Awareness Tool – Time Interval Comparison

Figure 1 shows the taxonomies for several RSS feeds. The TIC has been configured to display taxonomies for feeds aggregated at three time intervals: 6:00-7:00, 7:00-8:00, and 13:00-14:00 (Mountain Standard Time, US). Note the significant change in themes between 7:00-8:00 and 13:00-14:00. During that time interval, information about a ceasefire in the Mideast emerged in the news feeds.

The THEMAT and the TIC make it possible to track information changes in web news, in real time. In addition, given a knowledge signature of interest, users can personalize information searches by using it as the basis for a search of news feeds, blog posts, or scientific papers with similar knowledge signatures.

Figure 2 shows the knowledge signatures for two scientific papers about influenza vaccines accessible at the National Library of Medicine's PubMed website (http://www.ncbi.nlm.nih.gov/pubmed/). Both papers address similar issues, have similar keywords, and were retrieved using the same set of keywords. The knowledge signature, or hierarchy of themes, for each is different, however: safety and cross-reactivity are a higher priority in the paper on the left.

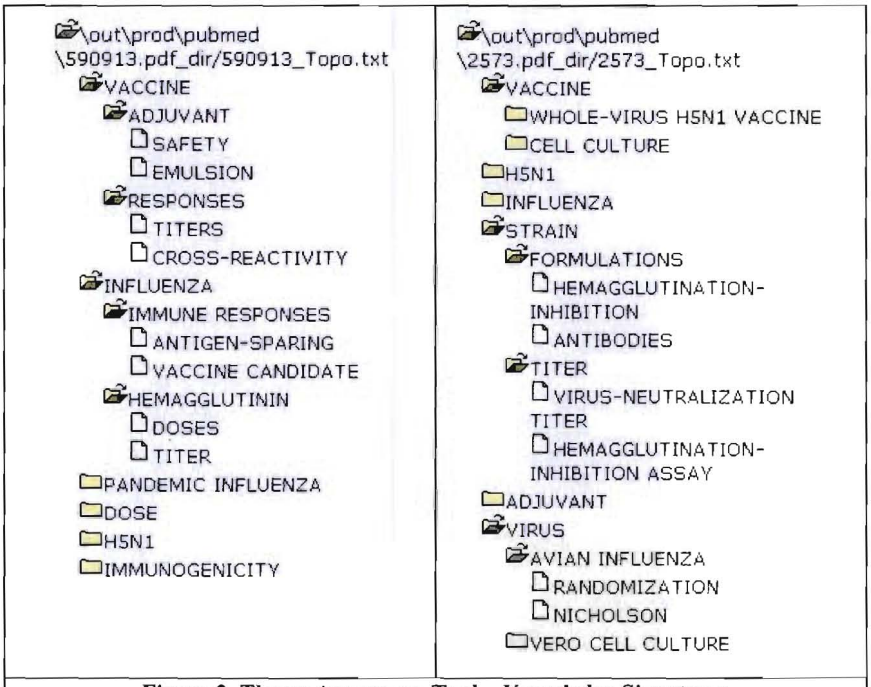

Figure 2. Theme Awareness Tool – Knowledge Signatures

Bibliographic records for more than 57,000 papers were retrieved in our digital library using the same set of keywords as in the example above. Using knowledge signatures rather than keywords would personalize the search query at a far finer grain of analysis and significantly reduce the number of results. The capability of personalizing information searches using knowledge signatures rather than a list of keywords could be critical in a global health emergency when time is scarce.

Social Awareness Tool (SAT)

Knowledge signatures can be computed after a collection is created, then, and once the collection has been created they can be used to find documents with similar knowledge signatures within the collection. But how is a collection of information relevant to an emergency created in the first place? In addition to RSS aggregation, collections can be created using keyword searches, focused web crawls, and metadata-based harvests via the OAI-PMH (Open Archives Initiative Protocol for Metadata Harvesting) (http://openarchives.org/pmh/).

Information extraction after documents have been collected is the basis of the Social Awareness Tool (SAT). Once a collection of information has been created using RSS aggregation, keyword searches, focused web crawls, or OAI-PMH harvests, specific metadata is extracted and stored in an RDF (Resource Description Framework) (http://www.w3.org/RDF/) database called a triplestore. The SAT retrieves information about authors and represents it in a network visualization, using the FOAF (Friend of a Friend) specification

(http://www.foaf-project.org/) and an open-source visualization tool, GUESS (Graph Exploration System) (http://graphexploration.cond.org). The result is a network visualization showing co-authors, or who knows whom.

Figure 3 shows co-authors of several papers. P.M. Mendelman has co-authored a paper with several people, including G. Kemble, who has authored another paper with other people. In an emergency, scientific responders can use the social network to determine who they know and, through them, how to contact people they do not know.

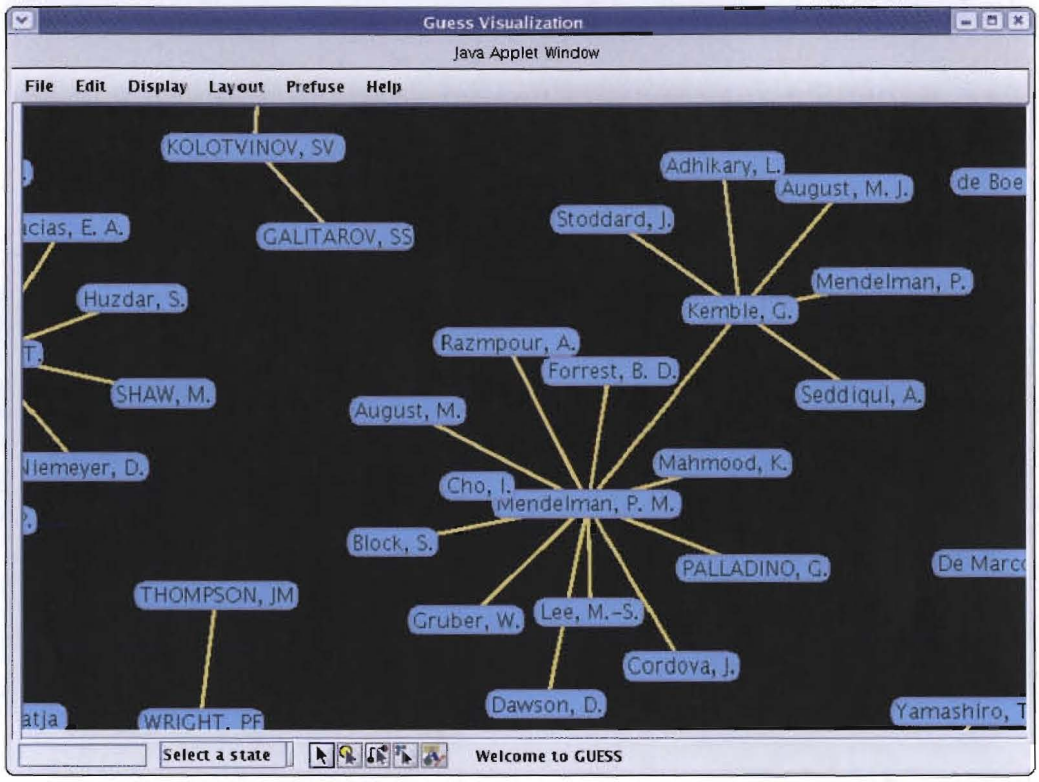

Figure 3. Social Awareness Tool

Like the THEMAT, the SAT can work with several kinds of content, including blogs. Using it with blogs allows users to view a network visualization of people who have viewed or commented on posts.

Further information can be extracted from blog posts such as the IP address and location of a blogger. In the future, we plan to integrate such information with the Social Awareness Tool in order to create a social network for a given geographic area, thereby personalizing situation awareness for all of the individuals in that area and enabling them to locate people nearby who can help.

Expertise Awareness Tool (EXPAT)

The Expertise Awareness Tool allows users to associate specific people with specific expertise. This tool builds on prior work, the Content Awareness Tool (CAT) (Collins et al., 2008). As users compose a document, the tool parses the text, creates a query, conducts a federated search of selected information sources or targets, and displays links to the results. An icon next to a link indicates a person with expertise in the field.

Figure 4 shows text about antiviral medications and links to related information, listed below the text box or placed on a map. Icons indicate two people with expertise in the field.

Using the Expertise Awareness Tool, users can identify specific people to contact based on their expertise. In the future, we plan to integrate the Expertise Awareness Tool with the Social Awareness Tool, making it possible for users to identify key experts within a social network.

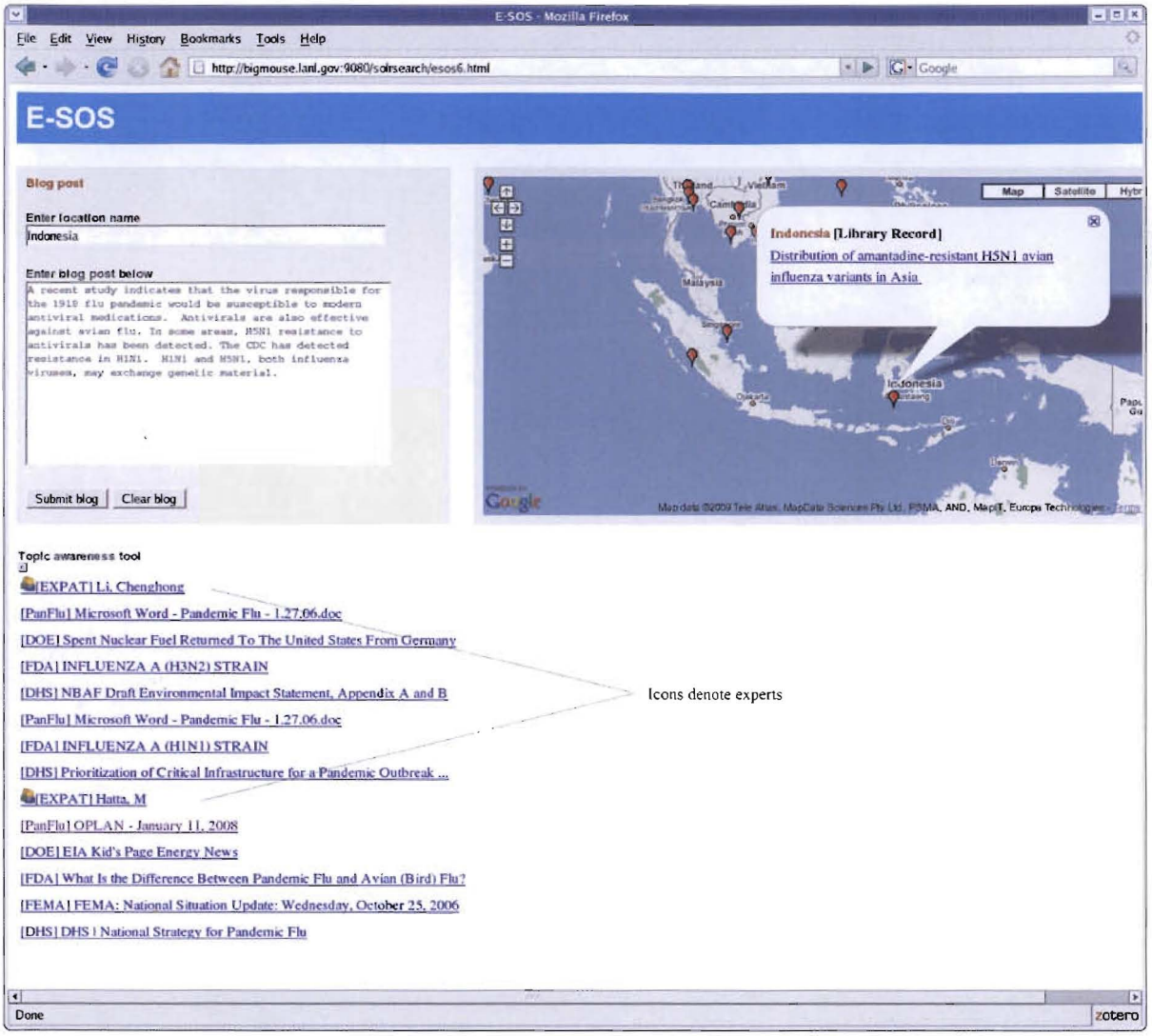

Figure 4. Expertise Awareness Tool

USER-CENTERED DESIGN

In order to create personalized situation awareness for scientific and technical responders, we work closely with individuals whose expertise and experience provides them with unusual, if not unique, perspectives. Since the system we are building is intended to be used by a small group of scientific and technical responders, initially, it is not feasible to conduct large numbers of interviews. Rather, it is important to conduct interviews with the key people who are in a position to know their own user requirements. Therefore all of the tools have been developed based on interviews with experts or in response to specific requests from experts. After the initial development of prototypes, we show them to experts and iterate as needed on the design. After development, we test our tools with a larger group of experts, responders, and – in one case – with the general public.

The Content Awareness Tool and Theme Awareness Tool are currently being tested by experts in pandemic flu planning in Florida's Department of Health to compare federal guidelines regarding state and local planning for pandemic flu with actual state and local pan flu plans. The content we are analyzing includes the White House's National Strategy for Pandemic Influenza Implementation Plan; pan flu plans for the US Department of Health and Human Services (HHS) and the US Centers for Disease Control and Prevention (CDC); pan flu plans for several states in the US, including Florida, California, and New York; and pan flu plans for two cities in the US, Miami and New York.

The Content Awareness Tool is being tested in the context of the Sonoma County Resource Dynamics Website, a collaborative endeavor between the Earth and Environmental Sciences Division at the Los Alamos National Laboratory and Sonoma County, California, US to create a community-based collaborative website for helping Sonoma County become the first carbon-neutral county in the US.

CONCLUSION

The Web enables greater personalization across space and time than previous technologies and this has implications for improving and personalizing emergency systems. In our research-in-progress we focus on leveraging these advances in web technologies to personalize situation awareness.

Much work remains to be done and, as long as technologies continue to evolve at a rapid rate, this situation will not change. As new technologies emerge, it will be important to continuously evaluate their potential use for situation awareness, in particular, and emergency systems, in general.

ACKNOWLEDGMENTS

The authors wish to thank Kim Thomas, Miriam Blake, Shelly Spearing, and Randy Michelsen for their support.

REFERENCES

1. Collins, L.M., Powell, J.E., Jr., Dunford, C.E., Mane, K.K., and Martinez, M.L.B. (2008) Emergency Information Synthesis and Awareness Using E-SOS. *Proceedings of the 5th International ISCRAM Conference*, Washington, DC, USA.
2. Department of Homeland Security Digital Library: http://www.hsdl.org/?homefront:blogsearch
3. Department of Homeland Security RSS feeds: http://www.dhs.gov/xutil/feeds.shtm
4. Endsley, M.R. (1995) Toward a Theory of Situation Awareness in Dynamic Systems. Human Factors, 37, 1, 32-64.
5. Endsley, M.R. (2000) Theoretical underpinnings of situation awareness: A critical review. In M.R. Endsley & D.J. Garland (Eds.), *Situation Awareness Analysis and Measurement*. Mahwah, NJ: LEA.
6. Endsley, M.R. (2004) Situation awareness: Progress and directions. In S. Banbury & S. Tremblay (Eds.), *A cognitive approach to situation awareness: Theory, measurement and application*. Aldershot, UK: Ashgate Publishing.
7. Environmental Systems Research Institute (ESRI). (2008) Public Safety and Homeland Security Situational Awareness. http://www.esri.com/library/whitepapers/pdfs/situational-awareness.pdf
8. Federation of American Scientists. Biosecurity blog: http://www.fas.org/blog/ssp/category/biosecurity/page/3
9. FEMA (Federal Emergency Management Agency) RSS feeds: http://www.fema.gov/help/rss.shtm#list
10. FOAF (Friend of a Friend): http://www.foaf-project.org/
11. GUESS (Graph Exploration System): http://graphexploration.cond.org
12. OAI-PMH (Open Archives Initiative Protocol for Metadata Harvesting): http://openarchives.org/pmh/
13. PubMed: http://www.ncbi.nlm.nih.gov/pubmed/
14. RDF (Resource Description Framework): http://www.w3.org/RDF/
15. Roman, J.H., Collins, L.M., Mane, K.K., Martinez, M.L.B., Dunford, C.E., and Powell, J.E., Jr. (2008) Reducing Information Overload in Emergencies by Detecting Themes in Web Content. *Proceedings of the 5th International ISCRAM Conference*, Washington, DC, USA.
16. Roman, J.H. and Spearing, A.S. (2008) Electronic Knowledge Management (eKM) Today. The 9th Annual Knowledge Management Conference & Exhibition, April 28-29, 2008, Washington, DC, USA.
17. Superstrain blog: http://superstrain.blogspot.com
18. Sutton, J., Palen, L., and Shklovski, I. (2008) Backchannels on the Front Lines: Emergent Uses of Social Media in the 2007 Southern California Wildfires. *Proceedings of the 5th International ISCRAM Conference*, Washington, DC, USA.