Project Highlight: GeoCollaborative Crisis Management

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ABSTRACT
The major natural disasters that occurred in the last few months have shown the importance and necessity for collaborative, international crisis management. Current geoinformation technologies are potentially powerful tools for mitigation, preparation, response, and recovery tasks in crisis situations; however, they fail to support group work and have typically been designed without scientific understanding of how groups (or groups of groups) work in crisis management to collect, process, and use geospatial information. The GeoCollaborative Crisis Management (GCCM) project investigates how groups utilize geospatial technologies in crisis situations and uses findings to design novel, multimodal (speech and gesture-based), collaborative interfaces for geospatial technologies.

Keywords
Multimodal Interfaces, Human-Centered Design, GeoCollaboration, GIS, Knowledge Elicitation, Crisis Management.

1. INTRODUCTION
The need to develop information science and technology to support international, collaborative crisis management has never been more apparent. The major Tsunami disaster that hit the Indian Peninsula in December 2004 indicated once again that international, federal, state, and local government agencies must develop coordinated strategies and adopt advanced and usable technologies to prepare for and cope with crises.

Our research addresses two overarching issues: (1) the understanding of geotechnology-based group work in crisis situations and (2) the development of geospatial information technology that enables better collaboration in same-place and distributed crisis management situations, utilizing multimodal (speech and gesture-based) interface technologies [1]. The GeoCollaborative Crisis Management (GCCM) project follows a five-tiered approach towards its scientific research objectives. The goal is to enable geotechnology-based crisis management through the following steps:

(1) understanding cognitive readiness in real world geo-collaborative activity,
(2) testing theories of cognitive readiness within team simulation environments,
(3) understanding technology enabled group work,
(4) developing natural, easy to use, multimodal interfaces to geospatial information technology, and
(5) developing Computer Supported Collaborative Work (CSCW) Systems that use shared visual displays to mediate discussion of site situation, and action for crisis management.

The National Conference on Digital Government Research, dg.o2005, May 15–18, 2005, Atlanta, GA, USA.

2. ACCOMPLISHMENTS
Over the last two years the research group was successful in establishing strong contacts with many local, state and federal agencies, which in return, contributed support to our research goals (e.g., by providing their real world expertise, access to personnel and field exercises, access to geospatial data, etc.). Through their support and enthusiasm for usable geospatial technology, we were able to conduct a range of ethnographic field studies, e.g. the use of mobile technologies in the West Nile Virus Program of the Pennsylvania Department of Environmental Protection [2], and observations of Pennsylvania Emergency Management Agency (PEMA) terrorist related field exercises. Additional GCCM agency collaborators are: Port Authority of New York & New Jersey: Operations and Emergency Management, U.S. Geological Survey, Florida Division of Emergency Management, National Geospatial-Intelligence Agency, Air Force Research Laboratory, Wright-Patterson Air Force Base, Federal Geographic Data Committee, U.S. Environmental Protection Agency, U.S. Department of Health and Human Services: Agency for Toxic Substances and Disease Registry, National Aeronautics and Space Administration: Earth Science Applications Division, the Centre Region Council of Governments, and the Penn State Office of Physical Plant. A yearly meeting with all collaborators has been a successful platform for maintaining and initiating contacts in the crisis management domain. The last GCCM meeting, held at the USGS in November 2004, attracted over 40 participants from the crisis management and closely related domains.

Our ethnographic field studies revealed that maps are essential collaboration tools in crisis situations. Project members were able to develop a theoretical framework for map-mediated collaboration and used this framework to design a prototype environment for developing and testing mobile multimodal components. In addition to field studies, NeoCITIES, a simulation software environment developed on an earlier project to assess group collabora-

tion is being extended and applied to understanding how domain experts (policemen, firemen, and EMS workers) collaborate knowingly and/or unknowingly in crisis situations [3]. A supplement NSF award to the project will extend this work to the development of a collaborative map-based web portal and the study of its use by collaborating teams involved in international humanitarian relief logistics.

As a component of our human-centered research, project members (with input from agency experts) developed three prototypes and several scenarios for Pennsylvania, Florida, and the metropolitan area of New York and New Jersey. The tiered research approach of the GCCM project also supported the design, implementation, and deployment of a multimodal large screen vision platform that supports situation awareness in crisis situations, gesture and speech recognition as means for human-computer interaction and an intelligent system-human dialog process [4]. Repeated usability assessments of prototypes are being fed back into system refinement [5]. Our industry collaborator, Advanced Interfaces, has developed a robust version of a large-screen multimodal prototype system, which is to be installed at the Port Authority of New York and New Jersey, Operations and Emergency Management facility.

3. THREE SHORT SUCCESS STORIES

3.1 Penn State Office of Physical Plant (OPP)

The Penn State OPP is supporting one project Research Assistant to develop campus GIS capabilities for emergency management and response on the University Park Campus. This work is being carried out in close interaction with OPP and with the local Centre Region Council of Government / Campus Emergency Response Coordinator. Initial emphasis was on building a database and developing desktop GIS tools. Recently, a first prototype mobile system has been developed and implemented.

3.2 Pennsylvania Department of Environmental Protection (PA-DEP)

PA-DEP has the goal of increasing their capacity to deal quickly with a range of environmental risks and crises. As noted above, our ethnographic field studies are guiding their future system design and they are providing expertise to help us target our basic research in geospatial information technology toward real world applications. As early adopters of mobile GIS technology, their real world experience with this technology has been invaluable.

3.3 The Port Authority of New York and New Jersey (PANYNJ)

Our industry partner Advanced Interfaces (AI) leveraged basic research on the GCCM (and previous) projects to develop "GeoMIP," the Geospatial Multimodal Interaction Platform. PANYNJ has ordered a dual plasma screen GeoMIP implementation for their Emergency Operation Center. The soon to be delivered platform will be used, initially, for demonstrations and briefings. The project team will use the opportunity to study system use by emergency management personnel as a key part of our Living Lab approach to understanding group work with technology and application of that understanding to improving that technology.

4. FUTURE CHALLENGES

Many important project challenges lie ahead. As noted above, the GCCM project just received supplemental funding to investigate how web-based geocollaborative techniques can be used to enable multi-agency, humanitarian relief logistics efforts. In this subproject we will be focusing on web-accessible, collaborative geospatial tools for knowledge management and activity coordination.

The project team members have been very successful in balancing the "science" and "practice" components to the research. This balance was clearly acknowledged by collaborators in the yearly team meeting, which highlighted theory-based geocollaboration research as well as prototype and product development (AI's GeoMIP). We will continue to build connections across multiple agencies, multiple levels of government, and other organizations. An important outcome of these strong relationships is access to field exercises and real world activities that are often inaccessible to academic researchers.

A large challenge that will be the focus in upcoming research is to translate domain knowledge (collected in the field) into scenarios and simulations that are constrained enough to properly test human-computer interaction while maintaining realistic components of cooperative work and cognitive readiness. The biggest challenge that lies ahead is testing the prototypes (e.g. GeoMIP) on site under real world conditions.

5. ACKNOWLEDGMENTS

This material is based upon work supported by the National Science Foundation under Grants No. BCS-0113030, EIA-0306845. Any opinions, findings and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the funding agency.

6. REFERENCES

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