Information Sharing Using Live Video in Emergency Response Work

Fredrik Bergstrand
Viktoria Institute
bergstrand@viktoria.se

Jonas Landgren
Viktoria Institute
jonas.landgren@viktoria.se

ABSTRACT

This paper presents findings from a design-oriented study focusing on emergency response work. Traditionally, information technology for emergency response work has included enroute navigation advice, resource management, hazard material databases, property information repositories, and situation reporting using sketching functionality. Now, a new class of information technology has become available, namely mobile live video capabilities. This paper presents initial findings from a study on how mobile live video capabilities could improve information sharing and situation awareness in emergency response work.

Keywords

Emergency response, collaboration, live video broadcasting, design

INTRODUCTION

The dramatic increase of wireless capacity, increased processing power on mobile phones and low-cost flat-rate subscription schemas has in short time opened up a new design space. This design space hosts a new class of information technology and associated information systems refereed to as mobile live video broadcasting. Technical improvements, new innovative web services with open API's and improved web standards has also drastically reduced the time to market and enabled a fast cycle of design, implementation and evaluation.

However, it is a slow process of bringing new innovative capabilities in to the everyday work of emergency responders. Innovative research prototypes are seldom evaluated as part of the everyday work practice but rather evaluated in field experiments or exercises; see for example Landgren (2007). This paper reports from a small-scale project where researchers, industry and emergency response professional join-forces in an action research oriented design project. The project has focused on how mobile live video capabilities could improve situation awareness between emergency response actors on accident sites and command centre settings.

RELATED WORK

This study relates to prior research on information systems and information technology in emergency response settings such as; information technology as an organizing resource (Calloway & Keen, 1996), key functionality in emergency management information systems (Turoff et al, 2004), improved design of mediated communication on the fire ground (Camp et al, 2000), ubiquitous computing to improve accountability and awareness for fire crews (Jiang et al., 2004). A common denominator for these studies is the focus on improving the ability to understand the situation faced by response workers on the accident site. The interactions between response workers are of particular importance. Studies by Landgren (2007), has shown that situation specific information is a key issue in fire crews' sensemaking processes. Situation information is a type of snap-shot information saying something about how someone currently comprehends a situation, and even if very brief or fragmented, it will affect and form how the response work will become organized (Landgren, 2007). Video is one type of material that could reflect situation specific information.

The use of live video data for supporting collaborative activities is not new and has been studied specifically in the domain of computer supported cooperative systems. A study by Kraut et al (2003) measured the potential improvement of physical task collaboration between physical co-located collaboration, video enabled collaboration and audio-mediated collaboration. They found that physical co-location might not easily be replaced by visual co-location when it came to physical collaborative tasks. In contrast to that study, we seek to explore how video can mediate aspects of a location and situation in order to provide material that influences the work in the remote location.

Studies of video capabilities of consumer mobile phones have shown that these new capabilities dramatically change mobile communication. The easiness of recording and publishing mobile video has consequences for privacy, transparency and our notion of context (Reponen et al, 2008). Mobile video provides a primary and secondary context. The primary context refers to the situation when the video is recorded and the secondary context refers to any remote situation when people use the published video. Reponen et al. (2008) argues that

the existence of a secondary context will affect the people in the primary context. This would change the way that people behave in everyday situations due to the dynamics of the secondary context.

RESEARCH APPROACH

This study focuses on how to improve situation awareness for emergency response actors by using live video broadcasting. The goal of this study was to design and deploy a working prototype that Incident Commanders, Paramedics and Command Centre Operators could use as part of their everyday work. In order to accomplish that, the design process included workshops, prototyping, reuse of prior ethnographic material of emergency response and a minor field study.

Four workshops were conducted in the fall of 2008 to establish common ground. The workshops covered general problem areas of the current handling of traffic accidents, the relation between the problem areas and possible technical solutions, and the current state of technical readiness within the organizations were the main topics of discussion. Collaborating parties in the workshop included one senior commander responsible for mobile IT, one incident commander specialized on traffic accident response work, one command center chief of staff, one senior disaster medicine doctor as well as an ambulance coordination manager.

The design process was run in an iterative cycle with ongoing prototyping and four workshops to provide input for design. Practical design work was initiated early in the design process in order to quickly materialize a prototype that could serve as a trigger for discussion in subsequent workshops. A minor field study of 33 hours was also done covering the work of incident commanders.

The application was deployed in mid November 2008. After four weeks of actual use of the application, informal follow-up interviews were made with four incident commanders, one chief of staff and one command center operator. The users were asked to describe how they have used the application and their opinions about using the application. The interviews were recorded and supplemented with handwritten notes.

APPLICATION DESIGN

The Liveresponse application has been designed as a mash-up that incorporates dynamic map services, live video support from several sources, and awareness features to support better informed emergency response work. The main feature of the application is the ability for response actors to broadcast live video from the incident site to a web-application in a matter of seconds. The broadcasts are captured using the Bambuser service on mobile terminals equipped with 3G networking capabilities and A-GPS positioning. The Bambuser service handles the live video and delivers geo-positioned Flash video material to the LiveResponse application. The application also features live video and traffic congestion data from Road Authorities' network of traffic surveillance cameras. Interaction with the traffic surveillance cameras, such as saving a still image from the video feed or marking a cameras area of view as an incident site results in a notification on the map. Awareness specific features in the application include an area in the map view where the events from the last 24 hours are presented and a log view displaying recent events. The log view presents newly added clips, images saved from the traffic surveillance video feeds and notifications when a user has sent information to an external actor.

The current users of the application consist of professionals from the Fire and Rescue Service (FRS), the Emergency Paramedics Service (EPS) and the Traffic and Road Authorities (TRA) in Gothenburg, Sweden. The TRA users consist of command center operators that monitor the traffic situation. The providers of clips from the field are the FRS and EPS.

RESULTS

As of December 2008 the application is in use within three organizations, the Fire and Rescue Services, the Traffic and Road Authorities and the Emergency Paramedics Services in Gothenburg, Sweden. The results from the initial field use are presented as excerpts from real use, user reflections and a tentative model of use pattern.

Excerpts from real use

City Bus incident

The city bus incident was broadcasted by the incident commander (IC) and the paramedic team. The clips were viewed minutes after being captured by the command center operator and a few minutes later by the chief of staff. During the following 24 hours the clips was viewed between five and seven times each by the incident commander, the paramedics teams, the command center operators and by the chief of staff.

Picture 1: The picture shows on the left the media reporting of an accident involving a town bus and a private vehicle, and on the right is a screen shot of the live broadcast made by the incident commander.

Car Crash Incident

During a single vehicle incident did the incident commander broadcast four clips to a receiving command center operator (CCO). Two clips displayed the rescue workers trying to free the victim, one displayed the empty wreckage, and the last one showed an overview of the incident site.

Picture 2: The picture shows the emergency responders trying to free the victim that is trapped inside a vehicle that has turned upside down.

User reflections

The following brief quotes outline some general user reflections about using the application:

> "It is difficult to remember to use the camera, sometimes I just forget about the mobile phone in my pocket." Incident Commander(1)
>
> "I think the application is good because the people at the command centre can now see what I see" Incident Commander(2)
>
> "The application is so simple and direct and provides a new dimension previously not available." Chief of Staff(1)
>
> "The video gives me a better understanding of the relation between my actions in dispatching resources and how it affects the situation on the accident site" Command Centre Operator(1)

The above quotes from the follow-up interviews indicate that there are some challenges targeting the issue of ready-at-hand versus ready-in-pocket (Pica & Sorensen, 2005). Due to the time-criticality on arrival at an accident site, the incident commanders express concerns about remembering to use the camera. However, when using the camera, they find the ability to broadcast a video highly useful in order to improve the communication with the command centre operators. The command centre operators also benefits of the video material by having new material that describes aspects of an emergency context as complement to the verbal reports. In a sense, the incident commander broadcasts aspects of the emergency context and the application allow this material to be shared across geographical and organizational contexts.

Patterns of use

Initial analysis of the video sequences, application log files and interviews show that the use of the application can be studied according to a pattern of use. This pattern has a temporal structure conceptualized as live, near

live, scheduled use, and post-incident use in the secondary context (Reponen et al., 2008). This pattern will be used as an analytical lens in the ongoing research of the application use.

Live. This type of use describes that the video sequence is viewed at the same time as the incident commander is broadcasting the specific sequence. The time-lag between broadcast and view has a 1-3 seconds latency imposed by the technical infrastructure. In our initial study we have not seen any episodes of this type of use.

Near live. This type of use describes that the video sequence is viewed in a short time period after the incident commander ended the recording. Clips are often viewed minutes after they were recorded, as the time critical work performed by the CCO seldom allows for a sudden task switch. Episodes of this type of use have been reported when the CCO has been seeking confirmation that the right amount of resources was made available for the incident.

Scheduled use. This type of use describes that the video sequence is viewed in a scheduled meeting, such as staff meetings or other conferences during an incident. The video clips can be used to visualize and inform about specific aspects of a situation. This type of use has been reported during our study.

Post incident use. This type if use describes how the video sequence is used after the end of the incident. The video clips have been used when completing incident reports and as material for the accident investigator in the work of analyzing why the accident happened. This type of use has been reported during our study.

DISCUSSION

The initial results from our study indicate that this new type of information technology provides new capabilities for emergency responders. As shown in the results, the Liveresponse application is in use and incident commanders and paramedics are broadcasting live video from accidents on an everyday basis. Further, as indicated by the users reflections the application is perceived useful even if there still are many issues that need improvements.

However, extensive analysis and a prolonged use of the application are necessary to uncover how live video will affect everyday emergency response work and specific actors' work-tasks. At this moment, we have only been able to perform limited analysis of the data that we have collected from the real use of the application. This means that our findings are only tentative.

As part of future work, we will use the situation awareness theory (Endsley, 1995) to analyze to what extent live video improves situation awareness for the command centre operators and other remote users. We will also use the concept of conversational grounding (Clark & Brennan, 1991) as an analytical lens to explore how live video affects the social construction of an emergency context.

CONCLUSION

The user feedback, frequency of use and results from the study has shown that this delivery model of rich situation specific information is useful for response actors. By being able to deliver video feeds from an incident site have positive contributions to the existing work practice. Incident commanders can provide a rich description of an incident site without having to formulate the complexities of the situation in words, the command center operator can develop improved situation awareness with the help of a better site description and several cooperating internal and external actors can also instantly take part of the information.

REFERENCES

1. Camp, P. J., Hudson, J. M., Keldorph, R.. Lewis, S., Mynatt, E.D. (2000) Supporting communication and collaboration practices in safety-critical situations. In Proc. CHI 2000, ACM Press.
2. Calloway, L. J. and P. G. W. Keen. (1996) Organizing for crisis response. Journal of Information Technology 11,1. 13-27.
3. Clark, H.H., & Brennan S.E. (1991) Grounding in Communication. In L. Resnick, J. Levine & S.
4. Teasley (Eds.), Perspectives on Socially Shared Cognition (127-149). Hyattsville, MD:
5. American Psychological Association.
6. Kraut, R. E., Fussell, S. R., and Siegel, J. (2003) Visual information as a conversational resource in collaborative physical tasks. Hum.-Comput. Interact. 18, 1 (Jun. 2003), 13-49.
7. Jiang, X., Chen, N.Y., Hong, J.I., Wang, K., Takayama, L., Landay, J.A. (2004) Siren: Context-aware Computing for Firefighting. In Proc. Pervasive 2004.
8. Kraut, R. E., Fussell, S. R., and Siegel, J. (2003) Visual information as a conversational resource in collaborative physical tasks. Hum.-Comput. Interact. 18, 1 (Jun. 2003), 13-49.

9. Landgren, J. (2007) Designing IT for emergency response work. Doctoral thesis. Gothenburg studies in informatics, report 39. Gothenburg University
10. Pica, D. & Sorensen, C. (2005). Tales from the police: Rhythms of interaction with mobile technologies. Information and Organization, 15(2): 125-149.
11. Reponen, E., Huuskonen, P., Mihalic K. (2008) Primary and secondary context in mobile video communication. Pers Ubiquit Computing, 12:281–288
12. Turoff, M., Chumer, M., Van de Walle, B., Yao, X. (2004) The Design of Emergency Response Management Information Systems. The Journal of Information Technology Theory and Application (JITTA), 5,4. 1-35