Towards collocated mapping of real-world events using mobile and wearable devices

Aslak Wegner Eide
SINTEF
Forskningsveien 1
0314 Oslo, Norway
aslak.eide@sintef.no

Antoine Pultier
SINTEF
Forskningsveien 1
0314 Oslo, Norway
antoine.pultier@sintef.no

Petter Bae Brandtzæg
SINTEF
Forskningsveien 1
0314 Oslo, Norway
petter.b.brandtzag@sintef.no

Abstract
This paper explores the possibility of using mobile and wearable devices to support collaborative collocated mapping of real-world events. Instead of focusing on the social impact of mobile collocated interaction, this paper focus on how this type of interaction can be employed to improve reporting of traffic risks, accidents, and near misses. Collocated users from an event area can be invited by the application to share, view, and edit information in a shared interface. Their knowledge can then be spread, sent to new users arriving in the area and be reviewed afterwards. The quality of the user generated content have the potential to be positively impacted by the use of wearable devices. Encouraging voting system and intelligent sorting algorithms will be employed. As sensitive information could be shared, privacy and security are discussed.

Author Keywords
Mobile, wearable device, sensors, places, data, safety

ACM Classification Keywords
H.5.m [Information interfaces and presentation (e.g., HCI)]: Miscellaneous.

Introduction

Research on mobile collocated interactions has traditionally been looking at how collocated users can engage in collaborative activities using smart phones and tablets, thus going from personal/individual toward shared/multiuser experiences and interactions [6]. Underpinning this research is the assumption that such shared collocated interaction may help mitigate some of the anti-social behaviour associated with the use of mobile devices, where people seem to be more concerned with staring into their screen than they are socializing with those around them [9].

To assess whether collocated interactions have the potential to reestablish and enrich physical face-to-face communication, researchers have studied various social contexts such as media sharing, team work, and storytelling [6]. Albeit important, these studies focus mainly on the social effects of collocated interactions by designing and testing systems that are specifically designed to foster face-to-face interaction. Less focus is given to whether mobile collocated interaction could serve other purposes than improving sociability.

In this paper we discuss how mobile collocated interaction can be beneficial for mapping of real-world events witnessed by multiple collocated individuals. Instead of looking at the social impact, the paper focus on how mobile collocated interaction, particularly supported by wearable devices, have the potential to positively impact the efficiency with which data can be collected and merged, and the quality of the resulting data set. A discussion regarding potential challenges related to the use of wearables for collocated interactions is also given.

Collocated mapping

The sensors and cameras available in mobile and wearable devices make them ideal for capturing data about real-world events, both in terms of images, videos, locations, environmental conditions and subjective descriptions. In one of our research projects, we are looking at how one can leverage these capabilities to collect good data on exposure to travel risks, accidents and near misses when people, for example, are biking home from work, enjoying their time in their leisure boat or taking a stroll in the city. This data can for instance be used to increase public risk awareness, to help governments in making roads safer, or as crucial input to emergency services.

A typical characteristic of many accidents and near misses is the involvement of multiple collocated individuals, each with their own valuable observations and descriptions of the chain of events. By providing a kind of shared interface that they can make use of to collaboratively describe and agree on a common and more complete story, one could increase both the efficiency of data collection and analysis in this context, and also improve the quality of the data that is being reported. Involved persons can connect to the shared interface using their own mobile or wearable device,and easily add images, videos, drawings and notes to describe the event. Interaction mechanisms can be put in allowing the users to collaboratively view, edit and combine information uploaded by others, finally ending up with a common story that all participants can agree upon. These individuals can be invited by the application, by sending relevant and contextual notifications.

In other words, this concept employs mobile collocated interaction to allow collocated collaboration in a shared

interface, using mobile and wearable devices only. This notion of using mobile collocated interaction to help collocated individuals map out real-world events could also be used in other scenarios.

Challenges

Privacy and security

Wearable devices may be seen as connected sensors monitoring their users. We think the collaborative mapping described in this paper must be designed in a way that it's not possible by design to extract personal information. In order to achieve this, robust cryptography and anonymity must be employed. In some case, a local P2P network over Bluetooth or Wi-Fi can also be used instead of broadband networks.[2] Users have to trust their wearable devices and not fear sharing information about any kind of event, such as political manifestations. A perfect security and privacy is difficult to achieve, but we think designers of said services should do the best regarding the state of art. For example, the applications may be open-source and their security should be audited.[8] Furthermore, an attacker can use a network of electromagnetic sensors for detecting the position of communicating wearable devices, and then their users. Solutions exist and may be used for hiding the actual data-stream in an energy efficient encrypted communication background noise.[5]

Quality of social content

We think a key point of collaborative mapping is user assessment. Social networks often allow the users to vote, sometimes only positively (e.g. Facebook's likes or Twitter's favourites). For collaborative mapping, we suggest a Suitable/Unsuitable voting system. These votes should not discourage the users, but improve the quality of the notifications and facilitate further analysis. Voting mechanisms can trigger unsatisfactory side effects to the quality of social content. When having a lot of content, users might look at only the most popular, ignoring new and potentially interesting content [4]. A solution can be to hide the vote statistics and serve the user an assortment of popular and new content. Furthermore, intelligent algorithms may be developed for determining the quality of social content [1].Anonymity in social interactions has positive and negative implications[3] which should be considered when designing a collaborative mapping system. In collocated mobile interactions though, the anonymity is not always a necessity since the users may be able to see each other in case of small events.

Encouraging participation

Many data source exists for real-world events and can help the users to start a session. We can imagine the integration of Twitter for detecting real-world events[7] along semantic parsing, in order to provide engaging notifications for the users in the situation. The application should be interesting and useful; it should provide information for the users and encourage participation. We think the enjoyment of mapping information about real-world events, in collaboration with other people is motivating.

Conclusion

In this paper, we have explored a concept for supporting collaborative mapping of real-world events using a shared interface which makes use of mobile collocated interactions. The main advantage of applying this interaction style in this context is to increase efficiency of data collection and analysis, and to improve the quality of the data that is being reported. The paper has also highlighted the main challenges of combining real-world events mapping, user generated content and wearable

devices. In future work we plan to develop and test a prototype of the described concept in the context of social collaboration on near miss reporting.

References

[1] Agichtein, E., Castillo, C., Donato, D., Gionis, A., and Mishne, G. Finding high-quality content in social media. In *Proceedings of the 2008 International Conference on Web Search and Data Mining*, WSDM '08, ACM (New York, NY, USA, 2008), 183–194.

[2] Al-Akkad, A., Ramirez, L., Boden, A., Randall, D., and Zimmermann, A. Help beacons: Design and evaluation of an ad-hoc lightweight s.o.s. system for smartphones. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*, CHI '14, ACM (New York, NY, USA, 2014), 1485–1494.

[3] Christopherson, K. M. The positive and negative implications of anonymity in internet social interactions: "on the internet, nobody knows you're a dog". *Computers in Human Behavior 23*, 6 (2007), 3038 – 3056. Including the Special Issue: Education and Pedagogy with Learning Objects and Learning Designs.

[4] Gilbert, E. Widespread underprovision on reddit. In *Proceedings of the 2013 Conference on Computer Supported Cooperative Work*, CSCW '13, ACM (New York, NY, USA, 2013), 803–808.

[5] Lopez, J., Rios, R., and Cuellar, J. Preserving receiver-location privacy in wireless sensor networks. In *Information Security Practice and Experience*, X. Huang and J. Zhou, Eds., vol. 8434 of *Lecture Notes in Computer Science*, Springer International Publishing (2014), 15–27.

[6] Lucero, A., Jones, M., Jokela, T., and Robinson, S. Mobile collocated interactions: Taking an offline break together. *interactions 20*, 2 (Mar. 2013), 26–32.

[7] Sakaki, T., Okazaki, M., and Matsuo, Y. Earthquake shakes twitter users: Real-time event detection by social sensors. In *Proceedings of the 19th International Conference on World Wide Web*, WWW '10, ACM (New York, NY, USA, 2010), 851–860.

[8] Schmeelk, S., Mills, B., and Hedstrom, L. Standardizing source code security audits. *International Journal of Software Engineering & Applications 3*, 1 (2012).

[9] Turkle, S. *Alone together: Why we expect more from technology and less from each other*. Basic books, 2012.