Opportunities, Challenges and a Testbed of Designing Crowdsourcing Systems for Public Safety

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1. INTRODUCTION

An increasing number of cities have opened up crime data. In the meantime, mobile participatory sensing has demonstrated its success in many different application domains [Zimmerman et al. 2011; Lane et al. 2010]. We observe a great opportunity of building a mobile crowdsourcing system to improve public safety. The basic function of such a system can be disseminating location-based open crime data and allowing people to comment or provide additional information related to safety related issue. Such a mobile crowdsourcing platform can improve people's awareness of local safety issues and services, as well as help law enforcement agencies better understand people's needs therefore to make optimal resource allocations.

However, most of open crime data provide historical rather than relatively recent or current crime data. For instance, the UK government releases crime data on its website www.police.uk where public safety incidents are visually represented on street-level maps. As Evans et al. [Evans et al. 2013] noted that "data often only arrives at Police.uk after a period of 4-7 weeks. The data indicates trends, but is not up-to-date or accurate enough to be able to help in tracking crimes as they occur - descriptive but not predictive of crime." Even though law enforcement agencies have started using social media to reach out the public, they are very cautious about collecting or releasing timely safety related information in a (mobile) social environment. Regardless of the concerns that law enforcement agencies have, people still want to receive safety related information more timely. How to design a mobile social crowdsourcing system that can enable an efficient and effective dialog between law enforcement agencies and the general public?

Institutions of Higher Education are required by Clery Act to log and publish safety incidents [DOE 2011]. Each log contains important information regarding a safety incident, such as the location, time of occurrence, time of report, incident description and incident type. The safety log is also required to be updated within two business days of the crime report. Because the timeliness and transparency requirement of campus safety log is much higher than general open crime data published by a city police department, and smart phones have been widely adopted by college students, we identify college campus an ideal environment for us to develop a testbed to test out the idea of designing a mobile crowdsourcing system for improving public safety.

2. MOBILE CROWDSOURCING DESIGN FOR PUBLIC SAFETY

We collaborated with the Department of Public Safety at Syracuse University (SU DPS), first designed and deployed a mobile app [SU DPS 2013] for only delivering public announcements of major confirmed crimes, such as thefts and robberies. But we soon realized that only pushing open crime data did not enable an efficient or effective dialog between the DPS and the public, we still need to improve the design of the reporting features.

In order to reduce the risk and engage people in this crowdsourcing system, we started with understanding the community's current reporting behaviors. We analyzed our university's safety log for the year of 2013 [E. Tan and Huang 2015] to detect relevant reporting patterns of the public in the

campus area, specifically pertaining to where, when, and how soon the community would report safety incidents. We discovered that people's reporting behavior changed significantly depending on location and time of day. Certain addresses and streets were also subject to the attention of the public due to a high volume of safety reports. Finally, the reporting speed of people changed depending on both their location and the type of incident they were reporting about.

Since time, location and crime severity level are three key elements that can be collected via mobile crowdsourcing, we also employed computational modeling techniques from cognitive psychology and conducted behavioral experiments to investigate how these three factors influence people's reporting decision-making [Huang et al. 2015]. In the initial lab experiments, each factor has three levels, leading to 27 different incident scenarios. Each scenario was presented in a random order 10 times for a total of 270 trials. The choice (i.e., to share/report the incident or not) and the response time were recorded for each decision. Our initial results [Huang et al. 2015] showed that participants were significantly more willing to share if the incident occurred near home, and they were much more likely to share for the more severe crimes. Time of day (collapsed across the other factors) had no effect on the probability of sharing, but location did.

Motivated by these findings and by the literature promoting interactive reporting systems, we designed a novel mobile app, called S4S (sharing for safety/support) [E. Tan and Huang 2015]. The design was developed to fulfill the following tasks. S4S should be able to collect safety related reports with more contextual information, enable sharing of reports with other users, notify users with new reports in a timely and appropriate manner, and allow users to access historical reports.

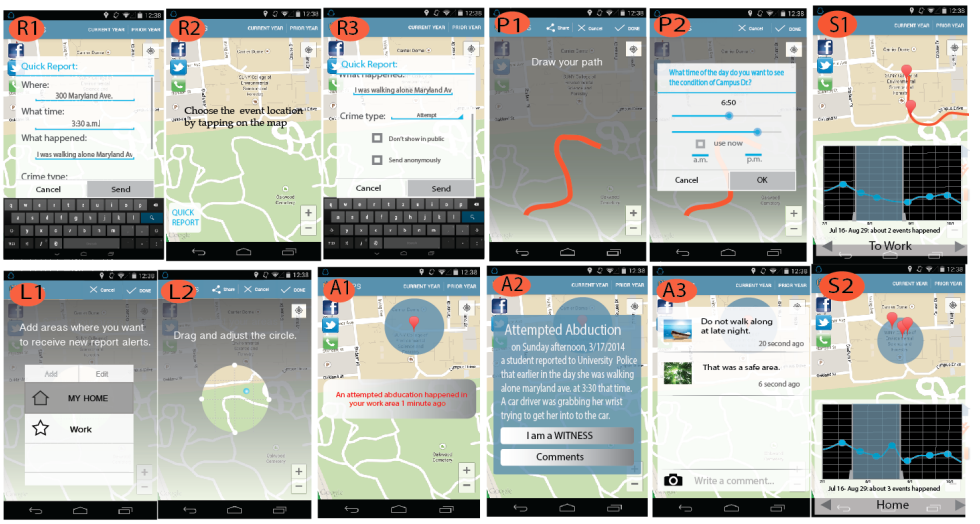

Fig. 1. Selected screens of the S4S (Sharing for Safety/Support) system design [E. Tan and Huang 2015].

In order to achieve the above design goals, we developed the following groups of functions, i.e., reporting an incident or a safety concern, selecting interested paths or areas, receiving a report notification, and reviewing historical reports. Because location was found as an important factor impacting people's reporting behaviors, all features involve location context. For example, the reporting features allow users to provide details of a report, and specify the incident location. To mitigate potential privacy or safety issues, users are allowed to share the report publicly, privately, or anonymously. The path/area selection features allow users to identify certain areas or draw some paths, if they are interested in

receiving new report alerts from certain specific areas or along some paths. Users can also identify a time when they care the most about, such that they will receive alerts instantaneously when criminal events happen near that path/area which has been drawn or indicated respectively. When a reported incident occurs within the identified area of a particular user, the reported location will be shown on this user's map, and the user can read the report message in details. Users can also comment on the report, or provide more details to the event by clicking on the "I am a witness" button. The system will then direct them to a quick report view in which more details can be sent directly to the Police Department. The reviewing features allow users to look up historical reports around the areas or the streets they identified when they customized the app.

3. A PROMISING RESEARCH TESTBED

We conducted paper prototype studies with 10 participants to evaluate the system design. All the participants thought this system can be very interesting and helpful. Some of them even expressed their interests in participating in the development process of the system. They also provided valuable comments and constructive suggestions to improve the design [E. Tan and Huang 2015]. Our continuing research built upon this testbed will make promising contributions to many important and interesting topics.

For example, a variety of factors have been found to influence people's decisions to report a safety incident, such as a cost-benefit analysis, racial factors, and social resources [Bowles et al. 2009; Xie and Lauritsen 2011; Black 1976; Goudriaan et al. 2004; Singer 1998]. Most existing research has focused on the perspective of the victims, while little is known regarding the motivation and involvement of witnesses in the reporting process. Our research can shed light into reporting behaviors of both victims and witnesses.

In addition, college campus area has a large number of temporary residents who are students or visitors, as well as permanent residents who either live in the neighborhood or have been working at the university for years. They may have very different knowledge of local safety conditions. They will have different needs of receiving public safety related information. They may also have different concerns about showing open crime data in public via a mobile social platform. For example, since temporary residents have little knowledge about local safety or community, they desire information about which areas are safe to walk by themselves [E. Tan and Huang 2015]. In contrast, permanent residents may be concerned about that publishing such data could have negative impact to the community (e.g., lowering the house price). These diverse community constituencies form a nice sample of a city population for us to study how to balance different stakeholders' requirements and needs.

In our user experiments, we have demonstrated how cognitive psychology decision models can help us understand how different factors impact people's reporting decisions [Huang et al. 2015]. We plan to conduct follow-up experiments to examine other factors. The experimental results will inform our system design, such that people may be more willing to share public safety reports.

Finally, we also plan to evaluate the novel area-based alert function in S4S [E. Tan and Huang 2015]. This feature could help mitigate information overflow (i.e., too many irrelevant incident notifications) as well as preserve users' location privacy. Users can identify areas that are close to their homes without specifying actual home addresses, and then users can receive notifications related to those areas. Such a notification also allows users to receive real-time event notification more timely, without being overwhelmed by other reports that they may not care about. This novel area-based map function can be applied in other location-based systems for either pushing or pulling information more effectively.

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