Digital Neighborhood Watch: To Share or Not to Share?

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Abstract
In this paper we survey HCI research relevant to crime prevention technology and identify a research gap towards validating the hypothesis that technology supporting social interaction between users is more effective than pure information-based crime prevention systems. Towards this end, we implement two versions of a crime prevention information system called SALUS, and present the design and first results of a field study aimed to evaluate how variations in the functionality of such crime prevention technology can influence: (1) citizens' safety perception, (2) the local crime levels, and (3) user interaction and satisfaction with the system.

Author Keywords
Crime prevention technologies; crowdsourcing; crime mapping; user studies; public good.

ACM Classification Keywords
H.5.m [Information interfaces and presentation (e.g.,HCI)]: Miscellaneous; H.4.m [Information systems applications]: Miscellaneous

Introduction and Background
In line with this year's CHI conference theme on HCI research for social good, this paper examines how technology can be used to implement an effective digital neighborhood

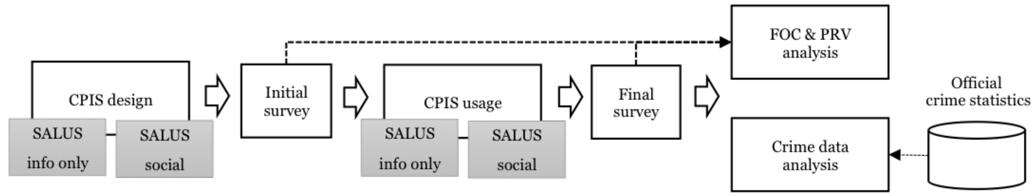

Figure 1: Overview of the study.

watch. Similar to a neighborhood watch group, users of a crime prevention information system (CPIS) could prevent crime by sharing information, alerting their neighbors of suspicious activities, and coming up with solutions together.

Crime continues to score as one of the top public concerns globally [17]. According to victimology research, high crime leads to significant psychological reactions with negative implications for both individuals and the society at large: fear of crime (FOC), defined as the negative emotional reaction to crime, and perceived risk of victimization (PRV), defined as the subjective evaluation of individuals regarding their likelihood of victimization. High levels of FOC and PRV were found to decrease quality of life [1], trigger antisocial behavior [9], and even provoke neighborhood breakdowns [4].

In the last years, HCI scholars have started to investigate how technology can support community policing activities and to outline basic design principles for technologies intended for crime prevention. A fair portion of the researchers, as well as law enforcement bodies, focus on crime prevention systems that provide users with information to lessen their victimization risk [3, 2, 23, 24]. This approach is supported by several *victimization theories*, like the *lifestyle exposure theory* [12] and the *routine activity theory* [5], which hypothesize that a criminal event happens when the offender's motivation meets the victim's vulnerabilities and a supporting environment. Crime prevention technologies that make use of this insight provide potential victims with information which would lower their chances of being targeted. As such, many governmental and commercial systems provide maps that identify crime hotspots in the city and usually use police criminal records as their main data source [24, 6, 25]. Blom et al. [2] on the other hand, investigate how users, especially women, can use a mobile application to tag contexts and regions in the city where they feel safe as well as unsafe, and how such technology can be used to alleviate fear. Blythe and coworkers [3] focus on the elderly with the goal of decreasing their fear by means of wearable technology that broadcasts video and audio data to the police and community sites. Finally, Satchell and Foth [23] design dedicated safety devices meant for use in different environments after dark to help users manage their personal safety concerns, e.g. by sending a distress signal to a buddy in case of a threat. All these studies explore how technology can lessen the victimization chances and/or increase the safety feeling of single individuals.

In contrast to the victimization view, the *social control theory* focuses on understanding communities. It states that social

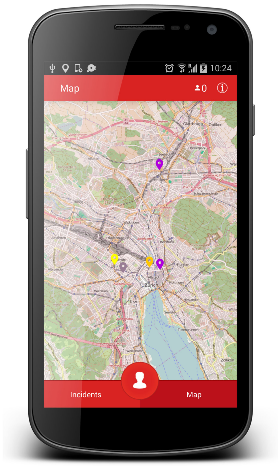

Figure 2: Map showing reported incidents in the central area of Zurich.

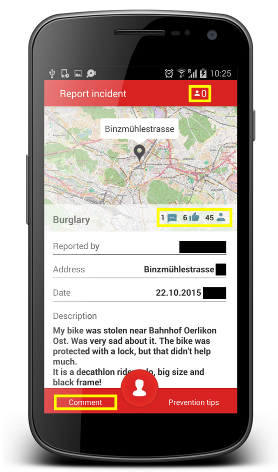

Figure 3: The details of a bike theft incident.

interactions between community members enforce social norms, which in turn shape criminal behavior [13]. Further research has found that neighborhoods with high levels of social cohesion and willingness to intervene for the public common good (characteristics known as high collective efficacy) exhibit lower crime rates [22].

Within the HCI community, Lewis and Lewis suggest that technologies intended to prevent crime should be designed to support communication and problem-solving discussions amongst residents, as opposed to simply providing information to them [16, 15]. Furthermore, a study based on interviews with senior police officers in India arrives to similar requirements for a social media based community policing approach [20]. The study concludes that the police would like to use online social networks to enable citizen policing by means of self-reporting and to keep residents informed and engaged through targeted and customized announcements and alerts. Going further, the same authors analyze residents' posts on the Facebook page of the city police in Bangalore and find that in addition to actionable information, online social networks can help assess FOC among residents and develop mutual accountability between police and the residents [21].

While the above research identifies the potential and promises of community policing technology, a fully-fledged CPIS is yet to be built, and its effects in terms of increasing collective efficacy and of lowering FOC and PRV levels, is yet to be measured. Of special interest is quantitatively testing the hypothesis that the integration of social features within a CPIS would yield better results than a pure information-based CPIS.

In the remainder of the paper we: (1) derive specific research questions to quantify the above hypothesis, (2) present a field study aiming to empirically measure the answers to the identified questions, and (3) design and implement two versions of a mobile application to gather the empirical data during the study.

Research Questions

To investigate the research gap identified above, we implement and evaluate two versions of a CPIS (an information-based basic version and an extended version allowing communication and interaction between users) and seek to answer the following two research questions:

RQ1. Within a CPIS, is enabling social interaction among individuals more effective than only providing crime-related information in terms of reducing: (1) FOC, (2) PRV, and (3) real crime levels?

RQ2. General understanding of the usage and user interaction with the proposed CPIS versions. Specifically, analyzing the two deployments in terms of: (1) how do users interact with the system, i.e. what are the most popular features and use cases?, (2) when, how often, and for how long do users interact with the system?, and (3) what are users motivations for content generation and consumption?

Study Design

The study phases are depicted in Figure 1 in chronological order. We first surveyed relevant research streams in the areas of HCI and victimology, identified research opportunities, and continued with the design and implementation of two versions of a crime prevention app (presented in detail in the next section).

The two CPIS have been deployed to users in the city of Zurich, Switzerland, with a planned usage period of 3 months, starting October 15th 2015. At the time of writing the study is still ongoing. To acquire users, we have lead a multi-channel campaign. Potential participants in three different

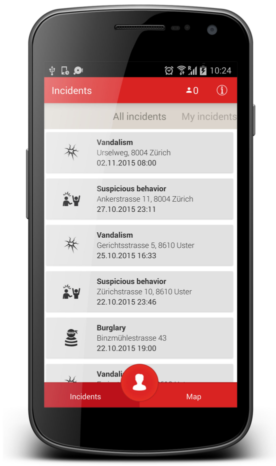

Figure 4: List showing last reported incidents received by the user.

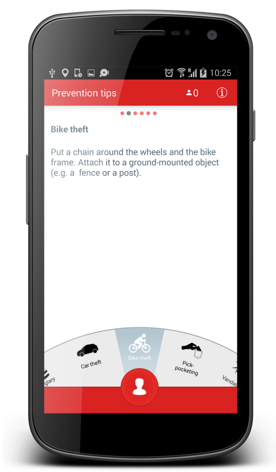

Figure 5: A list of prevention tips against bike theft.

neighborhoods of the city have been contacted via an official university letter briefly describing the aim of the study and asking for their participation. In addition, promotional material in form of flyers, posters, study website, and social media campaigns was disseminated [1].

Respondents were asked to fill in an initial survey, designed to capture their current safety perception, previous victimization, socio-demographic data, housing situation, and degree of neighborhood integration. FOC was operationalized by means of the following three questions [10]: *How safe do you feel walking alone in your area after dark?* (FOC1), *A relative or close friend of yours walks alone in your area after dark. How safe do you think this is?* (FOC2), and *How safe do you feel when you are home alone after dark?* (FOC3), each measured on a four-point Likert scale (1- very safe, 2 - relatively safe, 3 - a bit unsafe, 4 - very unsafe). PRV was measured for different types of offenses, over a binary answer scale (yes or no) as follows: *Do you think it is probable that over the next 12 months you will be a victim of the following offenses? (a) Personal theft, (b) bike theft, (c) car theft, (d) burglary, and (e) other.* (PRV) [14].

At the end of this first survey, the participants were assigned randomly to two different treatment groups, based on which they have received the download link to one of the two following versions of the app. **V1. Information only**: users receiving this version of the app have access to a common set of features on the platform, but no possibility for communication with other users. **V2. Social**: additionally to all features provided to the group above, users in this group have the possibility to exchange information with the other users via additional functionality – explained in the next section.

[1] See our project homepage: http://salusapp.ch

Upon completion of the test period of 3 months, users will be contacted again and asked to fill in a final survey, newly assessing their safety perception via the same operationalizations presented above. Additionally, users will be asked to rate the app functionality and to indicate their motivations for content generation and consumption on the platform.

The answers from both surveys will then be compared to assess if and how the two app deployments have had an effect on the research questions RQ1 and RQ2.

CPIS Design and Implementation

Based on the insights from an ideation workshop, usability surveys of two prototypes, and from several literature streams, the authors have already identified a list of six CPIS design principles (DP) in a previous publication [8]. Next to identifying key design principles for CPIS, this previous work proves that a CPIS would not spread panic among its users, but instead, it holds a potential to decrease the risk of victimization and to motivate its users to undertake preventive measures. In this work, we have chosen the following four core design principles for implementation in our first CPIS in the wild:

DP1. Information provision: through crime mapping, to establish transparency and raise exposure awareness among individuals.

DP2. Community involvement: through sharing information and advice among community members, to build and strengthen social ties within the community.

DP3. Preventive tips provision: a supportive function of the system for promoting preventive behavior among users and counterbalancing the provision of crime related information (which might be perceived as negative).

Screen	%
Main Menu	27.23
Notifications List (see UC3)	25.00
Crime Map (see UC2)	23.66
Incident Details (see UC1, UC3)	17.41
Copyright Information	1.79
Report Incident (see UC2)	1.79
Prevention Tips List (see UC4)	1.34
User Profile	0.45
Rest	1.33

Table 1: SALUS screens ordered by popularity.

DP4. Targeted notifications: through warnings in times of high risk, a mechanism to keep users engaged and returning to the system.

The two versions of the system were developed in form of two separate deployments of an Android mobile application named SALUS, after the Greek goddess of safety and well-being[2]. Both versions provide functionality across four main use cases (UC), that map closely to the design principles identified above, and are explained in detail below. They solely differ in the implementation of UC2, which in the SALUS social deployment contains additional social features.

UC1. Visualize crime related information

To avoid the cold-start problem, typical for new crowdsourcing applications where lack of content leads to lack of users and vice versa, trustworthy crime statistics originating from official police criminal records [18] have been used. Visualization of these statistics is achieved via a choropleth map[3], supporting two levels of aggregation: on municipality level and on district level. The absolute number of criminal incidents has been normalized to the number of inhabitants in the geographical unit, and provides a static information reflecting the overall crime level from the previous year.

On top of this, an additional layer consists of crowdsourced data in form of individual incidents. Each incident is represented by a pin on the map, with different pin colors representing different crime types (see UC2). By tapping onto a pin, a summary of the incident is provided. A printscreen of UC1 is provided in Figure 2. This use case is identical in both versions.

[2]See Wikipedia: https://en.wikipedia.org/wiki/Salus
[3]See Wikipedia: https://en.wikipedia.org/wiki/Choropleth_map

UC2. Share incidents

Common features. Users of both treatment groups are able to report crime incidents themselves. This is achieved in the map view by tapping over the incident location, or by creating an incident from scratch and typing in its exact address. Users can choose from six incident types: vehicle theft, bike theft, pickpocketing, vandalism (like littering or graffiti), and suspicious behaviour (like strong yelling) – the prevalent non-violent criminal acts that plague cities across the world. Additional details are required to complete the reporting: date, time, textual description, and an optional photo.

Features specific to SALUS social. To investigate the posed research questions and to promote the feeling of a digital crime watch community among users, following additional features have been implemented in the extended version. First, users are able to interact over the reported incidents by: *thanking* the author for sharing an incident, by *commenting* under an incident, or by *liking* a comment. For each incident: the numbers of thanks, comments, and of users that saw it are summarized. Furthermore, at any given time, a user in the social group can see the *current number of online users in her proximity* – a parameter set to a radius of 4km, the upper limit for walkable distance. For an example of a real report in the social productive deployment, please refer to Figure 3 (social features are highlighted in yellow).

UC3. Receive notifications

Each time a crime incident is reported, a real-time push notification is sent to all users in the city. Received notifications are accessible in form of a list, sorted based on recency and marked as seen/unseen – see Figure 4. From this list view, the user can open the details of any incident. This use case has the same implementation in both deployments.

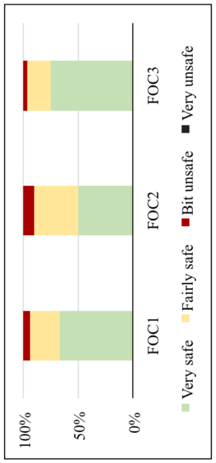

Figure 6: Distribution of fear levels across the three questions measuring FOC.

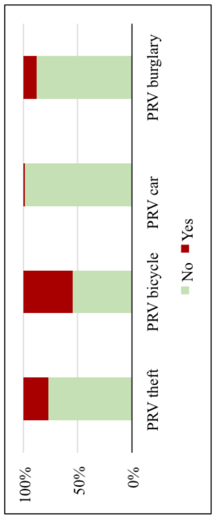

Figure 7: Distribution of PRV across the four polled crime types.

UC4. Get prevention tips

To provide richer and actionable content for the cold-start of the app, a static list of 55 prevention tips has been compiled from authoritative sources, like the Swiss Crime Prevention [19]. The tips span across the same six criminal categories as the incidents, leading to a 1-to-1 mapping from the incident type to a prevention tip type and enabling the linking of all relevant tips within the report detailed view. Figure 5 shows the first prevention tip for protection against bike theft. Users from both treatment groups have access to the same prevention tips.

Non-functional requirements

In order to prevent misuse, users are able to mark each incident as spam/inappropriate. This triggers an email notification to the administrators, which are then able to block the originating user and/or remove the incident. To assure their and other's privacy, users are identified by nicknames instead of real names or email addresses, and are advised not to upload pictures of other persons or with disturbing content. Furthermore, app usage of both deployments is tracked using Google Analytics [11], providing usage statistics to be compared and contrasted at the end of the study.

Preliminary Results and Future Work

As at the time of writing SALUS is still in use by the users, we choose to share some first insights from the initial survey (related to RQ1) and from the app's main features (as part of RQ2).

117 participants residing in the study area completed the first survey, whereby 51.3% (60) downloaded the information only and 48.7% (57) the social application. Among the participants, the majority are men (70.9%), between the ages of 15-39 (71.8%) or 40-64 (24.8%), and of Swiss nationality (60.7%). The vast majority live in an apartment (97.4%) as a tenant (91.5%). They either: live with their family but without children (29.9%), alone (27.4%), with their family and children (20.5%) or in a shared apartment (22.2%). Most participants report greeting their neighbors in the hallway (64.1%), while 26.5% chat with their neighbors regularly.

Figure 6 shows the distribution of the FOC1, FOC2, FOC3 variables, yielding in a high safety feeling among the participants at the time they have downloaded the app. In detail, between 50.0% to 75.0% of participants feel very safe followed by 21.3% to 39.8% of participants feeling fairly safe. No participants have admitted to feel very unsafe. On the other hand, the reported levels of PRV are high – see Figure 7. Up to 45.5% of the participants think their bike could get stolen within the next year, followed by 23.1% perceived risk of personal theft, and 12% perceived risk of burglary.

Table 1 presents the main SALUS screens ordered by their popularity as of January 11th 2016. While it was to be expected that crime incidents information is most popular (list view, map view, and details view scoring in total 66.07%), the very low hit rate of 1.34% scored by the prevention tips view comes as a surprise, as the authors found in a previous usability study [7] that this use case would be perceived as most useful. This discrepancy could be explained by the fact that the link provided in the incident details view was not salient enough.

Natural next steps are: completion of the final survey, full evaluation of the tracked usage data, comparison of the safety perception information collected by the two surveys, and evaluation of the local crime statistics – all to fully answer the addressed research questions. With this we aim to enrich the existing HCI body of knowledge and inform the design of next-generation CPIS.

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