User Study: Involving Civilians by Smart Phones During Emergency Situations

Amro Al-Akkad, Andreas Zimmermann

Fraunhofer Institute of Applied Information Technology FIT,
Schloss Birlinghoven, 53754 Sankt Augustin, Germany

{amro.al-akkad, andreas.zimmermann}@fit.fraunhofer.de

ABSTRACT

This paper concerns a preliminary user study to determine the acceptance of a mobile application that is supposed to involve civilians during emergencies. In particular, the focus is on bystanders. Their intervention during emergencies constitutes a delicate issue, since they were traditionally considered as a rather annoying party being merely observers of incidents. However, with the ubiquity and ever-increasing capabilities of cell phones there might emerge a great potential to flip the coin and to benefit from bystanders playing from now on a contributive role. To examine this hypothesis, we conducted semi-structured interviews with 24 persons. The result of our study shows that people are willing to use such mobile assisting system, and thus we take it as a positive starting signal to continue our research into this direction considering the elicited user constraints.

Keywords

User study, bystander intervention, semi-structured interviews, mobile sensing.

INTRODUCTION

This paper concerns a preliminary user study to determine the user acceptance of a mobile emergency application that is supposed to involve civilians (as bystanders, or victims) for supporting emergency response. In particular, the focus is on bystanders. Their intervention during emergencies constitutes a delicate issue, since they were traditionally considered as a rather annoying party, as they are merely observers of incidents. However, with the ubiquity and ever-increasing capabilities of cell phones there might emerge a great potential to flip the coin and to benefit from bystanders playing from now on a contributive role. Several mobile sensing applications as outlined in (Kanjo et al., 2009) have shown that dynamic data collection gathered by people carrying cell phones and sharing it for later analysis can provide a shared value for the common good. Investigations and studies of the relief work after the Hurricane Katrina demonstrate that cell phones were the communication technology that became operational at first (Farnham et al., 2006). Taking this as a basis, we claim that parts of the civil society are willing to actively contribute to the process of crisis management, if they are provided with the appropriate information and communication technology. In the scope of our user study we conducted semi-structured interviews where the interviewees were put into the situation to use a mobile application that facilitates civilians under certain constraints to contribute to the handling of emergencies that occur during a mass event and in daily life. For this purpose, we strongly reflect on a tragedy that happened in Germany in July 2010 during a mass event called Love Parade, where a mass panic caused: the death of 21 people, over 200 injured persons, and even more traumatic victims (Spiegel Online, 2010). At the same time, this tragedy represents the best documented catastrophe. On a dedicated blog (Love Parade Blog, 2010), visitors posted comments about their impressions, and also uploaded photos and videos. This catastrophe underlines the importance of documenting incidents: at first, the documentation from different sources per se represent different pieces of a puzzle that can be put together in order to understand the complexity of several incidents during a catastrophe, and second, it helps to accumulate evidence; the latter aspect, serves also as example, that civilians are willing to use smart phones to document incidents, although they might be shockingly.

Background: Bystander Intervention in emergency situations

For most people emergency situations are unusual and complex as well, except for those being regularly trained in a professional way to compete under highly severe conditions, such as police men, firefighters, or medical technicians specialized for emergencies. Literature about involving civilians in emergency response is scarce. This chapter serves to outline findings of bystander's behavior during emergency situations. We believe it is important to consider those findings to inform the design of a potential mobile emergency application.

Reviewing Statement: This full paper has been fully double-blind peer reviewed for clarity, relevance, significance, validity and originality.

"In the Kew Gardens section of Queens, New York on March 13th, 1964, a 28 years old young woman called Catherine 'Kitty' Genovese was brutally murdered while she approached her apartment entrance when returning back from work. Despite several cries for help nobody of the nearby people in the apartment building who heard Kitty's cries reacted accordingly. Although, the cries were heard from 38 witnesses from the time of 3:20am, it was not until 3:50am that somebody called the police." adapted from (Gansberg, 1964).

This assault is the prime example in psychology research on helping behavior. In American media the behavior of witnesses during Kitty's murder was portrayed as cold and uncaring, and terms like 'bystander apathy' labeled this incident. However, interviews with the witnesses and observations by social psychology lead to a quite different conclusion of why people might actually care, though due to a variety of reasons often decide not to intervene. These and further studies on helping behavior have proven the greater the number of people is present, the less likely people are to help a person that actually is in need of their help. In fact, when emergencies occur people who watch them rather are willing to help if there are only a few witnesses or nobody else except themselves. In literature, this pretended phenomenon of helping behavior has been coined to the term bystander effect. In particular, the seminal research of Darley and Latané during the late seventies (1968a) and (1968b) contributed to find out more about the nature and sequence of decisions that bystanders has to take when they witness an emergency. After Darley and Latané conducted a multitude of experiments and along this investigated into many real-world cases their studies evolved into a decision model that bystanders undergo when they get into an emergency situation. The bystander:

1. Has to see that there is an incident, though may fail to recognize so, and thus not provide any help,
2. Needs to realize it is an emergency. As some situations can be ambiguous, help can be prevented,
3. Needs to take responsibility, but might change his mind as hoping somebody else might help,
4. Has to decide on a technique of helping, though may not believe in his own skills to do so, and
5. Must execute this help, but this might be against his interest, if this incorporates a danger for him.

According to Darley and Latané two major reasons may call forth the bystander effect: First, the presence of other bystanders creates a diffusion of responsibility, i.e. when other observers are there individuals do not feel much pressure to take action, since the responsibility to undertake something is thought to be shared among all of those being present; this is step 3 in the above listing. And second, if individuals fail to react properly, in turn other individuals may interpret this as a signal that response is not needed or inappropriate. Further, their research has found out that bystanders are less likely to intervene if an incident reflects ambiguous impressions. For example, in the Genovese case many of the witnesses mentioned they believed they were witnessing a quarrel between lovers instead of realizing that the young woman was actually being murdered.

CURRENT APPROACHES TO MOBILE SENSING

Life without a cell phone seems to be nearly impossible for most of us: By the year 2013, experts expect the number of subscribers worldwide to reach the barrier of six billion (Kwok, 2009), and the number of smart phones to exceed 400 million sold units. Increasingly, cell phones become smarter and smarter, as they are equipped with a range of sensors: GPS, compass, temperature, acceleration, integrated camera, light dependent resistor, gyroscope, and more. Each sensor allows for gathering potentially rich data of the environment and of the person using a phone. As people carry cell phones nearly everywhere they go those can act as nodes in a sensor network, and thus represent an excellent source for collecting meaningful data in favor of the common good. With the ubiquity of cell phones and their (cellular) networks, the infrastructure is already provided for diverse applications that may explore and exploit the context of their users (Zimmermann et al., 2007). For instance, smart phones allow perceiving contextual data about the location of the user that is mapped to a certain instant of time. For the plausibility of the collected data the location and time are parameters that are not less important than the identity of the user of a cell phone (Burke et al., 2006).

Mobile Sensing

Carrying smart phones people can collect data in ways being previously not possible. This approach is called *mobile sensing*. The key benefit of mobile sensing consists in the mobility of a carrier medium, which is collecting data over a large region and for a given period of time. The collected data of each mobile sensor can be aggregated and processed in a backbone system, and shared with other peers, in order to better cope with highly dynamic and complex phenomena, such as traffic jams in and around large cities (Amin et al., 2008). Further, mobile sensing can provide coverage in areas where it is hard to deploy and maintain static sensors due to natural conditions or industrial constraints.

The following paragraph gives a delimitation of the terms Participatory Sensing and Opportunistic Sensing: Participatory Sensing describes the collection of data via mobile sensor nodes in close cooperation with the owner of a device. In this scenario, the user is fully involved in the process of collecting data, and consciously and actively in control of what type and amount of data will be captured by the system. Hence, such a personal data collection represents no real benefit for the common good. Only, if this data is shared among other users, new perspectives on the dataset arise from aggregation and analysis. However, employing handheld devices as sensor nodes poses new challenges for privacy, data security, and ethics as well. In this context, Shilton et al. (2008) introduce the concept of participatory privacy regulation arguing that privacy must be a participatory process that takes into account both individual preferences and social settings. As the individual needs and preferences change according to social situation, negotiations of data capture and sharing this data cannot be separated from a user's context. Opportunistic Sensing, in contrary, describes the data collection via mobile sensor nodes without requiring permanent input from the owner of the phone, i.e. the user remains unaware of the data being collected while she is interacting with her environment (Roggen et al., 2009). Of course, the system needs to provide the user with means for configuration, in order to maintain a minimal degree of privacy, but compared to participatory sensing the user does not intervene in the application's process of collecting data. On the other hand, opportunistic sensing does not interfere in the user's private or business processes and activities. Applications that base on a continuous acquisition of data would suffer from permanently waiting for a user to react to system requests. To which extent a user is willing to react to requests within a sensor network or by means of his sensor node to gather data is a central question that has been partly answered in the paper of Lane et al.(2008). Further their preliminary analysis shows that an opportunistic design approach yields a system that rather supports large-scale deployment and application diversity.

Mobile sensing applications have been applied in a number of scenarios like pollution observation (Paulos, 2008, Kanjo et al., 2009). The leading organization in research of mobile sensing is the CENS institute (2011). For example, a project called *walkability* (2007) undertook a campaign to support the degree of how walkable sidewalks in a community. People have been encouraged to report sidewalks with structural problems by taking photos with the camera integrated in their phones. Pictures get geo-tagged in Google Maps and become input data for urban planning in their community (Reddy et al., 2007). Schoenharl et al. (2009) developed WIPER a prototypical wireless phone-based emergency response system that is capable of real-time monitoring of social and geographical communication and activity patterns of cell phone users for recognizing unusual human agglomerations, potential emergencies and traffic jams in order to support emergency planners and responders on unfolding crisis events. Wirz et al. (2010) conducted a user acceptance study of a mobile system that is supposed to support both organizers and visitors of large-scale public events in emergencies and evacuation situations. Based on answers of 92 attendees at a city-wide public event, they found out that cell phones are the preferred medium for mobile emergency assistants. As a basis for the previous work, Wirz et al. (2009) designed an opportunistic sensing approach to collect data from the crowd. Their approach proved to autonomously recognize emerging collective behavior, such as queuing, herding, or clogging. Further, their emergency application strives to facilitate mobile interaction and information sharing between all stakeholders.

USER STUDY DESIGN

Vision and Goal

We envision a set-up where participatory and opportunistic sensing can support emergency response, i.e. both the active input of users (e.g. taking a picture) and the passive acquisition of sensor data of her environment (e.g. carbon footprint) is useful. We believe that the technological progress of smart phones will continue to go on rapidly as yet, this includes the improvement in: quality and number of sensors like acceleration or GPS, connectivity, storage, battery life-time, or dependability of mobile OSs and networks. Not least, we believe it is necessary to involve the views of different stakeholders including psychologists, engineers, emergency professionals and further experts, for studying how humans may behave in emergency situations and how they would utilize smart phones under complex conditions. The goal of this user study is to evaluate our vision of involving civilians during emergency response through the use of smart phones.

Procedure and Interviewees

Two days before launching the user study, a pilot study with one interviewee was arranged to identify potential problems in advance. Hence, we rephrased some questions to be easier to understand, changed the order questions appear, and refined our scenario to be more coherent. With 24 persons we conducted face-to-face semi-structured interviews (Wood, 1997) to gain a thorough understanding. We preferred this interview technique as it is a well-proven instrument for collecting qualitative data by setting up a situation that allows an interviewee the required time and in particular the scope she needs to talk about his opinion on a specific subject. For this we framed the interview with a three-stage scenario, after each stage questions were asked. The set of

prepared questions comprised 6 closed and 14 open-ended questions, i.e. some questions were suggested by us and some arose naturally during the interview. With a voice recorder we recorded the answers, and further took some notes along each interview session; upon a declaration of consent participants were asked to sign. The interviews were conducted in Germany within a research organization. This institute employs circa around 200 persons, including basically scientists and administrative workers. The scientists had an academic background from different fields of research: computer science, psychology, educational science and mathematics. Administrative workers are assigned to different tasks: key and lock service, accounting, international affairs, network administration, and graphical or web design. The interview is subdivided into five sections, which we describe in detail in the following. Not least, we asked interviewees to inform us about any idea, or negative and positive aspect they had in mind. One interview usually took between 15-20 minutes.

Structure

Demographic data

Demographic data as the gender and age were requested. Furthermore, an interviewee had to indicate if she represents a first-aider inside her organization. Due to their experiences people who have given first-aid usually can better estimate the constraints of using a mobile emergency application.

How the Cell Phone is used

Relevant information about the participants' phone and the way how she deploys it was examined: First, we asked about the frequency the phone is carried when she is en route. Then, if she possesses a smart phone, and if yes what model it is. Moreover, we asked which application and services she primarily uses. We completed this section by asking the user if she anytime got into a situation in which she were missing a specific sensor on their phone, e.g. a GPS sensor for facilitating navigation support.

Experience with accidents or large-scale crisis

We asked each interviewee if she ever has experienced an accident as an outbreak of a fire, a car accident, or persons being injured or collapsed with exhaustion. Further, we asked if she ever has faced a large-scale crisis as a natural disaster or a terroristic attack. Our ulterior motive of both questions was twofold: First, such questioning helped us to value her experience when emergency situations occur. And second, we hoped by posing preparatory such questions to make it easier for the interviewee to place herself in the given scenario where they were asked how possibly to utilize smart phones in emergency situations.

Scenario

Our scenario consists of three parts. After each part we asked questions. We choose a scenario where we put the interviewee into two different situations:

At first, we ask the interviewee to suppose to visit the Rheinkultur, a local mass event taking place each year in the city of Bonn, in Germany. Motivated through the national catastrophe that happened during the Love Parade event—as explained above—the city and the organizers like to deploy in a field test a mobile emergency application that enables visitors to contact the organizers in case of an emergency. In advance, the local media informs its citizens about the idea of testing this application and if visitors have not already downloaded it their service provider informs them by sending a SMS. In this context, we raised two questions:

1. If in general she sees a personal benefit in to install such an application while knowing that in background it continuously gathers data (by sensors embedded in her phone) about her environment in order to prevent critical phenomena as mass panic?
2. If she would use actively the application to collect evidence, e.g. for taking a photo of a quarrel.

Second, we asked if she would use the application during an emergency occurring in daily life. We place the interviewee in the following situation:

She has a walk at the Rhine River in Bonn. After some while the local command post contacts her and informs her that a severe car accident on the Kennedy Bridge caused the outbreak of a fire (see Figure 1), and asks her go circa 50m north along the river to take a photo with her smart phone of the incident site, and finally send it them through the application.

Following two questions:

1. How she prefers to be contacted via call, SMS, email or not at all?
2. What is her general opinion of the approach to involve civilians in emergency situations?

According to our pilot user we should stress, that the application is distributed through a campaign, so that a solid fundament of credibility is provided before telling the users about launching it.

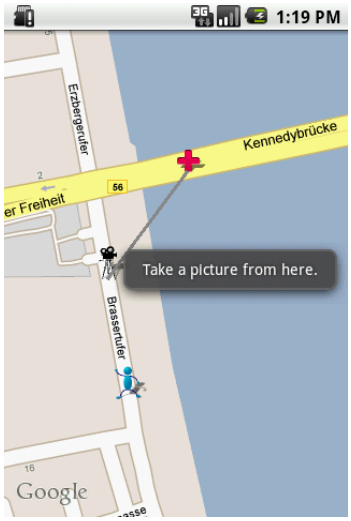

Figure 1 Mockup built on Google Maps

Further, he explained that it is better to start with describing the emergencies that may occur during big events, as due to the Love Parade tragedy these would be more graspable to the interviewees than the other scenario situation, and thus may lead to fewer misunderstandings. We draw both scenario situations with intent on the need to apply both participatory and opportunistic sensing in order to strengthen our hypothesis that through mobile sensing civilians without professional first-aid background can become contributive during emergencies.

Deployment

Not least, a well-adapted deployment strategy is mandatory for the later widespread use of an application. As, in the study of Wirz et al. (2010) it was already elicited that smart phones are the preferred device for mobile emergency assistance during mass events, we decided to skip this question. Though, we asked interviewees how the application should be made available and further if it should be a separate application or an extension.

EVALUATION RESULTS AND DISCUSSION

The way we designed and conducted the interviews basically served for imposing qualitative data, though, besides those, as we are still in the beginning of our design process, we preparatory collected quantitative data.

Demographics

In total, we interviewed 24 persons: 13 (54.2%) females and 11 males (45.8%). Their age averages 32.3 years and ranges from 19 to 55. Nine interviewees were administrative workers, and the rest have an academic background in computer science, psychology, educational science, or mathematics. According to a regulation of the German staff association (Berufsgenossenschaft, 2010) any organization that employs over 20 persons has to train at least 10% of its employees in first-aid. Among all interviewees five (20.8%) are eligible first-aider; three of them were female. Three of them supported the idea of such an application, though strongly advised against involving observers with no first-aid background in emergency cases, as in extreme situations people usually behave differently. The other two persons told that its usage at bystanders with little first-aid experience is possible, though under certain constraints. For instance, taking photos of a car that is damaged is something different, than documenting a car accident where the passengers are severely injured. All others reported they had to do a first-aid course for being able to register for the driving license; though, now most do not really remember the emergency procedures, i.e. if they would face an emergency they would be unsure what to do.

Use of Cell Phones, Smart Phones, and Technical Affinity

12 interviewees (50%) reported they always carry their phone with them, except if they forget it. 10 persons told us they almost carry it permanently with them, but during sports like jogging, meetings, restaurant visits, or lunch at work, they omit it on purpose. One reported she does not carry her phone when she walks in the forest, as she believes cell phones do not belong into it. Another reported not to dare taking her phone with her to big events, as she owes an expensive smart phone she is afraid that it would be stolen inside the mass. 14 respondents (58.3%) owe a smart phone. Two of the ten that owe a simple cell phone reported they owe an iPod,

which they often use for surfing the Web. One explained she used to have a smart phone, though after some while switched back to a simple cell phone, as she was wasting too much time playing with it. Another mentioned not owe a smart phone as those are still too expensive, though at work she enjoys working with them. Not least, one clarified a simple cell phone is handier, as current smart phones are still too big in size for putting them in his trouser pockets. Mainly all use their cell phone for calling and SMS. 15 persons (62.5%) use the camera, but at the same time they prefer to use an enhanced digital camera if available to gain higher quality. However, we expect that in future cell phone cameras will allow for taking higher quality photos, and thus this attitude might change. One reported to take photos with his phones only for linking them to its contact list. A few record video, though also if no other enhanced device is present. Many surf the Internet not only for usual business as email or Web sites, but for requesting dynamic changing data. For example, to request traffic jam incidents, map routes for GPS navigation, train routes after missing a follow-up train. One respondent who owes a simple phone admitted when she is in company of somebody who carries a smart phone it is often helpful, e.g. to find the way through a city.

Experienced Emergency Situations

Six interviewees (25%) have experienced accidents in which victims required their support including first-aid from applying a pressure bandage after intersecting a tendon, via giving mouth-to-mouth resuscitation and cardiac massage to collapsed person, till pulling out badly injured persons of crashed cars and putting them in recovery position. Four (16.7%) interviewees faced an accidental situation as a car accident, though first-aid was already provided by others reaching before. Moreover, there is a willingness to help before accidents may occur, e.g. one interviewee reported she had once called the police after seeing that a fallen tree partly blocked the drive-up to an autobahn. Solely, one respondent has ever experienced a large-scale crisis. A very strong earthquake hit the scene, when he was inside his apartment located in of L'Aquila, a small town in central Italy. He was one of those who were most nearest to the epic point of the earthquake. *"Everything went down. My building was newly constructed. It did not collapse, but was half broken from the middle. I've just survived. Right after this the whole mobile network was jammed, because of the immense amount of traffic that went across the network."* 308 people are known to have been died because of this natural disaster. Our interviewee even had to move to another place for continuing his studies, as buildings of the university in the old part were severely damaged. We asked him carefully if he gave any first-aid: "When my friend was running out of the building some pieces from the roof fell down on him, so he was injured, and I had to help him out. Some small children downstairs were crying, and I put them out."

Willingness of Using Emergency App, Personal Benefit, and Reasons for Rejection

Our scenario (see previous chapter) consists of three parts, though first build one situation and the third part another. In this sense, interviewees were asked twice if they would use the mobile emergency application: during the mass event and during the car accident on the bridge. 19 (79.17%) confirmed they would use it during the major event and 20 (83.4%) for the car accident on the bridge. However, this positive feedback is framed by diverse boundary conditions we will elaborate below. Further, some respondents that agreed on using the application in the first situation denied its usage for the second and others vice versa. Expressed benefits to install it were, e.g. the fact to become oneself a victim, to support the organizers of a big event in order to provide its visitors a higher degree of security, or to avoid the development of wave movements that can turn into a mass panic, or to be informed in time not to go this or that way—in this context the application was often compared to a dynamic traffic jam detector. Some interviewees agreed to install it due to scientific curiosity, although they cannot recognize a personal benefit. For this, they first need to probe it in real-world deployment. Five denied installing the application for the mass event, as the location is always transmitted and this is not to be shared permanently. Further, a mistrust of information sharing exists (referring to the Love Parade catastrophe): "…on purpose information is objected to the visitors in order to avoid crisis like a mass hysteria." Then, they are technical doubts: "I believe movement patterns can be recognized, but before I use it you really must prove me that it works properly." Also, one interviewee expressed he believes it would be less expensive to employ enough human observers during big events than utilizing cell phones for antagonizing emergencies.

Initial Behavior, Usage, Documenting, and Contacting in Emergencies

In general, respondents told us they would first go to victims and help them. Even, if a brawl happens some would interfere. When they cannot help anymore, they would look for surrounding people who may help or for relief units (paramedic, security etc). For the case no support is near, they make an emergency call. In this context, many expressed if the Emergency App would provide such a feature, they are willing to use it. As a matter of course, it was emphasized that the use of the application must be straightforward, in particular that means users are able to perform tasks as short as possible. Also, all data transmitted must be free of charge. Against this background it was proposed to include a part where first-aid skills are explained for remembering

how to execute different emergency procedures as controlling vital functions or taking off a helm. During mass events often the same incidents occur, e.g. a fire breaks out, people collapse, brawls. For this the Emergency App should be designed in a way that it facilitates to quickly notify relief units about an emergency situation. Such an application can be the fundament and for each specific mass event an extension may be provided. In this context, it was also mentioned to insert an emergency key on the phone. It could state a request similar to the common known one in airplanes when looking for an available doctor. None of the interviewees agreed to document emergencies in general. Most explained they consider such a behavior as voyeurism or morbid. Further, to publish something like this on the Internet would infringe upon the privacy and rights of the victims. Only four respondents (16.7%) confirmed they would take photos or record videos under specific conditions. One explained she would share photos she had taken of a natural disaster, e.g. on facebook. But, if the object depicts injured humans, she may only share it via the Emergency App expecting it to be trustworthy. Further, it was explained that in urgent danger probably one might not think about documenting things, as it is something different to a car accident where immediately documenting damages has become quite usual. However, one explained he may document a brawl to identify the offender(s), but only if he is out of danger. Also, it was reported not to document injured people, but for instance a hit-and-run offense or a pickpocket in action. However, the incidents during the Love Parade blur this clear result of non-documenting incidents. There, some people were initially shocked, but then used their phone for documentation. They vindicated such behavior, as it is more helpful than just standing uselessly around (RTL II News, 2010). Not least, during the earthquake in Chile in February 2010, facebook has shown to be a tool for vital communication, besides for social networking (Leticia, 2010).Six interviewees (25%) explained they prefer to be contacted by both call and SMS. Eight (33.3%) conveyed they prefer to be called, as it allows for inquiry from the bystander, and reading a SMS may take too long or receiving it may even be unnoticed. If the application reflects a design that enables its users to pose quickly inquiries to the command post, a respondent mentioned he probably prefer to be contacted by SMS. Seven (29.7%) preferred being contacted by SMS, as calling them might be too pushing or distracting. Further, sometimes it takes too long to hold the cell phone ready to hand, e.g. if it is in someone's trouser's pocket, then the call is often missed. Based on this, we phrase a new question for our ongoing work: Should users be able to assign how to be informed by the application (sound, vibration etc) under certain conditions?

Authenticity, Privacy, and Trust

All interviewees are concerned about misusing their privacy, i.e. they insist on data being made anonymous, and that is only used for retrospective analysis. Further, the installation of the application must be very easy, and its removal even easier. Beyond this data should be removed after an event, if nothing happens. One claimed by experience data is used generally for more than declared. Further, some respondents communicated the fear of creating a surveillance society while gathering mass data from mobiles, as they believe it is better to be spare when sharing data. More technical affine interviewees already knew that in Germany the service provider applies radio location, and can give this information to the security service for criminal prosecution. Some only accepted to use the application during the mass event, as there it would be part of an enclosed system. In this context, one interviewee supported the idea of mass data collection, but at the same time he pointed out that there are cases where only a very little part of data is used for later investigation. To clarify his point of view he explained the current use of CCTVs: *"Theoretically, every ten thousand car is recorded. Practically this data is only evaluated when something like a bank robbery happens. Then, the car license number is filtered out. The movement data of mobiles already are tracked, in principle you care about something about you don't need to."* Further, another respondent conveyed to know that his service provider is always tracking him: *"I know it, I agreed on it as it may be helpful, and if I don't want it, I just switch off my phone."* Also, some expressed they like to decide upon some privacy profile which data to share and which not. Additionally, one interviewee expressed he is motivated to use the application, if its design allows its users to see how data is used, i.e. which actions have been taken upon collecting his data. During one interview we accidently forgot to mention that the Emergency App is propagated through a campaign. Thereon, the interviewee rejected to use it in such a case, by reason of missing authenticity, i.e. how would he know if it is really the local emergency command post who contacts him or if somebody is playing a bad trick on him. Similarly, another interviewee emphasized she would only accept calls from the command post, if it goes through the Emergency App, as anything else lacks authenticity. Of course, this requires the application to be established. Besides, starting a campaign before it is launched, its usage can be explained in tutorials at school. One interviewee denied its usage for the mass event, as the location is always tracked and she has strong mistrust this is linked to her personal identity, but proposed an alternative way by using RFID-based wristbands to gather data streams instead of cell phones. Further, a respondent explained there must be anti-abuse rules to prevent its misusage. Not least, the integrity of persistent data is a delicate issue *"I trust the command post, but what is if this data gets into the hands of a third party?"* In particular, if personalized data is made public the victims or their relatives may be harmed; in the past data being published on the Web showed how strong the resonance of information made publicly available can be.

Ethical and Legal Issues

One experienced first-aider had concerns about involving normal civilians, as he experienced it is difficult to estimate the skills of untrained people: *"…in extreme situations people react differently or do not know how to react properly"*. He advised us to keep it in the hands of professionals, e.g. a registration can be managed by the German Red Cross. Then, by their allowance the command post can directly track its civil supporters by GPS, instead of using the loop way by first contacting their service providers. Further, he explained users should consciously use the Emergency App to guarantee that some motivation and moral courage is behind its usage. Another interviewee expressed he likes the approach to benefit from bystanders, but that by hindsight those bystanders may become victims, as facing emergencies may evoke a traumatic experience. Further, one interviewee described our approach as a mixed blessing: on the one hand you get a mass of data that generally allows for a better analysis, though if too many get involved an agitation of gapers might come up that may unintentionally harass other people. Optimally, a sophisticated algorithm is applied that strives for asking enough people for their support—while persons who are a first-aider are preferred—without any disturbance. Moreover, one respondent had legal reservations towards its usage, e.g. what happens if based on his input (e.g. a photo) the first responders take an improper action. Further, it was suggested that there should exist regulations for what which data is intended to be used for, and at the same time a bystander should always have legally the right to reject his support if he fears his own life, or mental and physical state, or he is afraid to make the situation worse. One interviewee liked the approach, as it utilizes a society in order to protect this society; the people in the society carrying cell phones represent a free and dynamic resource that is used to pursue a higher goal. Noteworthy, was also a discordant statement expressed by one interviewee: *"while sitting here I rather would not take a picture of injured people due to ethical reasons, though if I'll be in such a situation I probably would do."* Also, the issue was raised that people may be contacted while they are in hurry, and therefore will reject to accept calls or read SMS; though, we think if the emergency application is assigned a distinct way of signalizing an alert, this issue would be solved. Further, the committee that launches the Emergency App has the responsibility to inform its potential users well. People should not draw a picture, that such an application will always spike any harm. Not least, one respondent implicitly asked for technical high streaming quality: support in emergencies should not be misused for gaping on how other people suffer. Hence, she proposed to use the cell phones camera to record a video stream that is transmitted to the command post, so that no irrelevant data is kept on her phone.

Preinstalled Vs Download, Separate App Vs Extension

Three do not matter if the application is preinstalled or needs a download. 13 (54.17%) reported they prefer to download it, as the it offers a better transparency, the freewill is warranted, and not least it is easier to remove than being anchored in the OS. Five favored a preinstalled set-up, but it should be in a deactivated mode that can easily be switched, especially for elderly persons this is a design requirement. A pre-installation is an implicit request to participate, but at the same it offers the possibility for rejection. Only one mentioned that the application should be preinstalled and activated as well. Though, this approach lacks gentle deployment strategy, as it would force a registration before being able to work with the phone. 19 interviewees (79.17%) prefer to install a separate running application, as it is easier to find in the menu, and missing dependencies can be avoided. Further, it is difficult to allocate to an existing application; it can be built on existing applications like Google Maps or a photo program, but it still must be a separate button due to its importance. Only, two preferred to integrate it. It was suggested to integrate it into web browser. By this it can prevented to fall victim to the ever-changing specifics of mobile OS. Also, it was proposed to build it into a coherent navigation application. This comprises, besides navigation on streets, support for: finding available parking places, guiding to meeting points (e.g. pub). During mass events users may be reminded on which stage their preferred artists will soon perform. Due to the immense noise it is difficult to phone or read SMS—a visual list showing where the companions currently are would help.

Concerns about Technical Constraints

One interviewee explained he likes the idea of mobile data collection to support emergency response, though he is concerned about the battery consumption. When continuously data is transmitted from his phone, the battery will not last long. Further, the permanent transmission from a large number of devices may lead to a network overload or collisions. In fact, Schürmann (2010) reports that in the beginning of mass events or in large German cities during rush hour the GSM network is often overloaded, and a certain amount of time is needed to let things slide until the network works again properly. Also, one interviewee mentioned current smart phones do not have all required sensors and their quality is also not the best. Providing both requirements would now turn into more expensive smart phones, though we believe that after one decade the market will offer satisfying solutions in this regard. Also, it was raised that current radio determination is fuzzy, so inaccurate data may lead to making wrong decisions.

CONCLUSION

In this paper, we reported about a user study of how people estimate and may act when being involved as usual civilians in the process of handling emergencies by exploiting their smart phones. In particular, we claim that bystanders can play a more contributive role regarding the recent trends in mobile communication technology. Our analysis indicates that most interviewees support our approach, though they emphasize to prefer people with a first-aid background. The overall feedback we got corresponds to the study of Wirz et al.(2010), where 82.6% of 93 questioned people agreed. However, the deployment of our proposed mobile emergency application is wider. Besides supporting big events, it is intended to support incidents that may happen in daily life. The result of our study shows that people are willing to use such mobile assisting system, and thus we take it as a positive starting signal to continue our research into this direction considering the elicited user constraints; privacy and ethics represent sensitive issues. Further, open questions to answer are: Who has the authority to own collected data and how to supervise these? As, the results were solely collected from persons working inside a research organization, they have to be viewed as non-representative in respect of the wider population. This user study is based on hypothetical services. In future, we plan to conduct studies that involve an implemented set of services. Also, we need to introduce different classes of bystanders carrying a smart phone. First, people that maybe in hurry, and therefore might not want to help. Second, civilians without a profound medical background though are willing to help. And third, people who are first-aiders or practice a medical profession. Concluding, we reuse our results as a starting point in the frame of a soon starting research project that strives for improving the collaboration and communication between first responders, command post, police and civilians during large-scale crisis.

Participatory and opportunistic sensing represent the two limiting points of a conceptual spectrum that creates a design space for the implementation of mobile sensing applications. The degree of user intervention needs to be determined on a case-to-case and application-dependent basis. For emergency response applications may exist that explicitly require user input or activity, e.g. a bystander needs to take a photo of a specific aspect of the incident site and to send it to the official command post, and then proceeds with opportunistic sensing. We think that the support of emergency response through bystanders requires a hybrid approach, in which participatory and opportunistic sensing alternate in a type of shared initiative. Hence, we like to coin a new concept called *shared initiative sensing* that considers participatory and opportunistic sensing as complementary solutions.

ACKNOWLEDGMENTS

We like to thank all interviewees. Further our special thanks go to Leonardo Ramirez who was the pilot of our user study. Without their constructive feedback the writing of this paper would have been impossible.

REFERENCES

1. Amin, S., Andrews, S., Apte, S., Arnold, J., Ban, J., Benko, M., Bayen, A. M., Chiou, B. & Claudel, C. (2008) Mobile century-using GPS mobile phones as traffic sensors: a field experiment. In World congress on ITS. pp. 4.
2. Berufsgenossenschaft (2010) Grundsätze der Prävention - Zahl und Ausbildung der Ersthelfer (BGV A1 § 26), http://www.pr-o.info/bc/UVV/1/26.htm, Access date: 2010-12-16. Präventionsrecht-digital GbR.
3. Burke, J., Estrin, D., Hansen, M., Parker, A., Ramanathan, N., Reddy, S. & Srivastava, M. B. (2006) Participatory sensing. In Procs. of Sensys, Worldwide Sensor Web Workshop. pp. 5. ACM.
4. CENS (2007) Walkability Project, http://urban.cens.ucla.edu/projects/walkability/, Access date: 2011-01-03.
5. CENS (2011) Center for Embedded Networked Sensing, http://research.cens.ucla.edu/, Access date: 2010-12-13.
6. Darley, J. M. & Latané, B. (1968a) Bystander Intervention in Emergencies: Diffusion Responsibility. Personality and Social Psychology, 8, 7.
7. Darley, J. M. & Latané, B. (1968b) When will People Help in a Crisis? Psychology Today, 2, 4.
8. Farnham, S., Pedersen, E. & Kirkpatrick, R. (2006) Observation of Katrina/Rita Groove Deployment: Addressing Social and Communication Challenges of Ephemeral Groups. In: ISCRAM 2006, pp. 11. Newark, NJ, United States.
9. Gansberg, M. (1964) Thirty-Eight Who Saw Murder Didn't Call the Police. pp. 3. The New York Times.
10. Kanjo, E., Bacon, J., Roberts, D. & Landshoff, P. (2009) MobSens: Making Smart Phones Smarter, IEEE Pervasive Computing, 8, 50-57.
11. Kwok, R. (2009) Phoning in data. Nature, Macmillan Publishers, 458, 3.

12. Lane, N. D., Eisenman, S. B., Musolesi, M., Miluzzo, E. & Campbell, A. T. (2008) Urban sensing systems: opportunistic or participatory? In: Proceedings of the 9th workshop on Mobile computing systems and applications, pp. 6. ACM, Napa Valley, California.
13. Leticia, D. (2010) Earthquake in Chile: Chilean Photographers Communicate Through Their Work. Lens Ethics, http://www.lensethics.com/2010/03/01/earthquake-in-chile-chilean-photographers-communicate-through-their-work/, Access date: 2011-01-03.
14. Love Parade Blog (2010) Documentation (in German) of the incidents that happened during the mass panic at the Love Parade event, http://loveparade2010doku.wordpress.com/, Access date: 2010-12-18.
15. Paulos, E. (2008) Environmental Monitoring with Mobile Phones (Ghana), Wireless Technology for Social Change: Trends in Mobile Use by NGOs, Case Study 10. pp. 3. United Nations Foundation, Vodafone Group Foundation.
16. Reddy, S., Burke, J., Estrin, D., Hansen, M. & Srivastava, M. (2007) A framework for data quality and feedback in participatory sensing. In: Proceedings of the 5th international conference on Embedded networked sensor systems, pp. 2. ACM, Sydney, Australia.
17. Roggen, D., Forster, K., Calatroni, A., Holleczek, T., Yu, F., Troster, G., Lukowicz, P., Pirkl, G., Bannach, D., Kunze, K., Ferscha, A., Holzmann, C., Riener, A., Chavarriaga, R. & del R. Millan, J. (2009) OPPORTUNITY: Towards opportunistic activity and context recognition systems. In: IEEE International Symposium on a World of Wireless, Mobile and Multimedia Networks & Workshops, 2009. WoWMoM 2009. , pp. 6.
18. RTL II News (2010) „100 Tage: Loveparade – Die Tragödie von Duisburg“ (English translation: "100 days: Love Parade - The tragedy of Duisburg"), play time: 02:22:00. (Ed, Bohning, P.), pp., Germany.
19. Schoenharl, T., Zhai, Z., McCune, R., Pawling, A. & Madey, G. (2009) Design and implementation of an agent-based simulation for emergency response and crisis management. In: Proceedings of the 2009 Spring Simulation Multiconference, pp. 12. Society for Computer Simulation International, San Diego, California.
20. Schürmann, H. (2010) Handynetze sind überlastet. Handelsblatt GmbH, Date accessed: 2010-12-10, http://www.handelsblatt.com/technologie/mobile-welt/mobilfunk-handynetze-sind-ueberlastet;2600472.
21. Shilton, K., Burke, J. A., Estrin, D., Hansen, M. & Srivastava, M. (2008) Participatory Privacy in Urban Sensing. pp. 7. eScholarship Repository.
22. Spiegel Online (2010) Love Parade Catastrophe, http://www.spiegel.de/international/germany/0,1518,745908,00.html, Access date: 2011-01-03.
23. Wirz, M., Roggen, D. & Troster, G. (2009) Decentralized Detection of Group Formations from Wearable Acceleration Sensors. In: Proceedings of the 2009 International Conference on Computational Science and Engineering - Volume 04, pp. 8. IEEE Computer Society.
24. Wirz, M., Roggen, D. & Troster, G. (2010) User Acceptance Study of a Mobile System for Assistance during Emergency Situations at Large-Scale Events. In: 3rd International Conference on Human-Centric Computing, pp. 6.
25. Wood, L. E. (1997) Semi-structured interviewing for user-centered design. interactions, 4, 48-61.
26. Zimmermann, A., Lorenz, A. & Oppermann, R. (2007) An operational definition of context. In: Proceedings of the 6th international and interdisciplinary conference on Modeling and using context, pp. 14. Springer-Verlag, Roskilde, Denmark.