Social Networks Analysis for Victims Information Recovery on the Emergency Scenario

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Abstract. *The growing use of mobile devices by the population and the high popularity of the social media in current society, such as Facebook, produce plenty of information with contextual data. One obstacle to the emergency response team during the response phase of emergency management is to obtain information that could lead to solving a particular situation involving victims. In this paper we present a proposal which aims to collect information from social media and mobile devices, identify the contextual information and analyze them to indicate people who could help in the identification of victims.*

1. Introduction

The widespread use of mobile devices and the boom of the social media that currently occurs in our society suggest the use of these resources to address problems and unexpected situations that evolve over time and put lives or property in danger. The work presented here is aiming to analyze the contextual information found in mobile devices and social media to help in emergency situations. The critical question we are addressing is the lack of reliable information about emergency victims.

The main idea of this work is to infer the closest people in the victim's social network and recommend them, thus helping the emergency team to collect important and trusty information about the victims. We think that by analyzing their interactions in social media and mobile devices we can identify closer friends of a victim who are nearby the disaster local, thus improving the recommendation process.

2. The Emergency Management Issue

This work has its focus in the response phase of the emergency management's life cycle. This phase is the most complex and therefore the most studied of them all. Some factors that deal with complexity are the unpredictability and the speed of events, number of involved people, time to make decision and uncertainty about the situational awareness.

One of the biggest challenges of the emergency response team is to obtain reliable information on accident victims who are missing or unconscious. How could the emergency response team act to find information about these victims? Most likely they would have to ask people related to the event for more information about these victims.

3. Proposal: Contextual Analysis

We present a process that starting with the missing or unconscious victim's name can build his/her social network through collecting the contextual information contained in the mobile devices of people nearby the emergency scenario and the social media.

This solution aims to provide means of minimizing the work of the emergency response team in collecting information about victims of an accident, while trying to maximize the reliability of this information (recommending only those people that are most relevant to this process of information collection, i.e., the closest people to the victim), thus speeding up the victim's rescue procedure. The objective of this work is people recommendation, which is based on the social relevance among them.

3.1. Social Relevance

The main goal of our proposal is to identify the users' social relevance. As data sources, the interactions on Facebook, phone calls and SMS texting are used. We calculate the social relevance using parameters presented in Table 1. The social relevance calculus tries to identify the affinity of the victim with someone else. In the recommendation process, the next step is ranking and identifying people with high social relevance.

Table 1. Variables related to the social relevance

Variable	Meaning
Relationship Distance	Number of friendship links between two persons. The distance is 1 for direct friends, 2 for the friends of friends, 3 for friends of friends of friends, and so on.
Relationship Type	Kind of tie or link among people. We divided it in: LLR (Long Live Relationship – parents or spouse), Friend, Family (be member of), Co-worker and Acquaintance.
Relationship Weight	Some types are stronger than others. So, we define some weights to these types: LLR – 5; Friend – 4; Family (be member of) – 3; Co-worker – 2; Acquaintance – 1
Number of Connections	Frequency of communication among people: number of exchanged SMS, e-mails, calls and interaction in social media (comments, likes, content sharing and others).

We analyze the contextual information contained in the users' social network and mobile device so we can infer the social distance among them. To properly do this, we analyze certain characteristics of the victim's social network, such as the type of relationship among people, the weight of this relationship, the number of distinct connections between them, i.e., the number of relationships types between two people.

3.2. The Overall Process

Our proposal has a three tier client-server architecture. The first tier is the web server, a repository for exchanging and researching users' data. The second tier is the command and control server, a mobile server that is represented by the system installed on mobile devices used by the emergency response team. This node is responsible for sending queries looking for people that can help in an emergency. The last tier is the mobile client, represented by the system installed in mobile devices used by the population.

When the user installs our application on his/her mobile device, it sends some information to the web server, which stores the user information and searches for more useful information about him/her on the social media, forming an information cache. All his/her contacts in mobile phone are sent to be processed, as also frequency and duration of calls and SMS. These data is processed to identify the social distance among users.

During an emergency, the responsible team will seek information about the victims. The command and control server sends requests for mobile clients within a pre-defined action radius. The mobile clients search the user's social network after the query matching. In case of a matching, the client indicates that the user knows the victim and the degree of importance of this relationship. If none of the mobile clients in the vicinity of the emergency site accuses any relationship with the victim, the web server is reached for the contextual analysis of the victim's social network.

The web server checks the information about the victim, first seeking the data in the previously constructed cache. In this cache we have the social distance from a person to his/her friends or acquaintances. The web server returns a response to the command and control server with the identified victim's social network. Closest users to the victim are recommended to assist the emergency responders, following the pre-established selection criteria. This process can be viewed in Figure 1.

Figure 1. Proposed solution process

3.3. Privacy Issues

Wagner et al. (2010) shows that in the social networks context, its participants are more diligent and careful about sharing other people's information compared to when sharing their own. Novice users can be privacy insensitive due to failing in comprehending how the information is used. Usefulness of information sharing services was acknowledged in more stressful situations as in crisis scenarios. In such situations, information usefulness outweighs privacy concerns. We are aware of the research implications regarding the user's privacy. Our solution needs to collect sensitive information such as, user contacts, incoming/outgoing calls and their duration, number of messages exchanged. Therefore, it is important that we address privacy and security issues.

We will use the data collected only in emergencies situations, and only a list of the contacts names that matches the query will be provided to the emergency response team. Only the emergency response team will have access to this list and we will not provide the contacts phone numbers. All data provided by the application will be encrypted before sent to the emergency response team. In addition, the system will include options to I) provide the data automatically (always provide the data), II) provide the data only in certain time periods (configured by the user) and III) provide the data manually (requesting permission to the user before providing the data).

3.4. Implementation

So far we have implemented and tested the data collection from the user's mobile device. The prototype takes as input the victim name and searches the user's contacts

list. For each matched entry, we check the calls, the last call date, the calls duration time and the amount of exchanged messages. This data will be used to calculate the social closeness index of the contact (in relation to the user – the mobile device owner). After creating the contacts' social closeness index, the user's mobile device sends to the response team a list of contacts that matched the query, ordered according to the social closeness ranking along with contact extra data.

One of the main goals is to provide means of avoiding the homonyms problem. Thus, we found necessary to send extra data, so that emergency responders can quickly eliminate these "false positives". Through the analysis of the contacts ancillary data, the emergency response team can confirm that he/she is really the victim we are looking for.

3.5. Related Work

In previous studies, the focus was to get any information about the victim by providing a unified repository about the victims of an emergency. We focus on the recommendation of persons who can provide reliable information about the victim. The Katrina People Finder Project [Murphy and Jennex 2006] was creatad in response to dozens of groups collecting lists of "lost and safe" for those affected by Hurricane Katrina. It created a system to enter data according to a standard format, and aimed at other sites collecting this information, encouraging them to use the database, avoiding duplication of effort.

The Google Person Finder [Google 2010] is an open source web application that provides message boards and records for survivors, family and loved ones affected by natural disaster and seeks to provide information about the status and location of people. The database and API are based on the People Finder Interchange Format [Yee 2011], a XML format used to exchange information on individuals identified after a disaster.

4. Conclusions and Future Work

We have yet to improve the prototype, implementing the social media data collection functionality and building the social closeness heuristics. As for the social closeness algorithm and the ranking construction, we already have something in mind, but still have to test it. We have to discuss the above mentioned issues and some others. We will take additional actions in order to improve the treatment of the privacy and security issues for the user's information collected. We aim to run some synthetic data tests and also plan to run some field tests in cooperation with Brazilian emergency organizations so we can see if our proposed solution is feasible.

References

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