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Abstract

Driven by several issues from earlier commercial public alerting projects, this paper investigates people's opinions in regard to the current and expected deployments of mobile location-based services under national emergency alerting and warning systems. In particular, the paper examines general public perspective of the importance of utilising the services in different types of emergency events, categorised as natural and human-caused. A survey was carried out to fulfil the requirements of the investigation. The findings clearly denoted significant differences between the mean ranks of all emergency types in the two categories, providing evidence that the importance of utilising LBS is perceived differently by the public for different emergency event types. It is expected that such validated criterion of investigation would help systems' designers to narrow down their selection of emergency event types to only those with extremely high significance to the public, hence avoiding the possibility of ending up with people opting out from the system as a consequence of being continuously bombarded by notifications for emergency events including minor ones.

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Rankings of Importance of Location-Based Services Utilisation for Emergency Management

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Abstract

Driven by several issues from earlier commercial public alerting projects, this paper investigates people's opinions in regard to the current and expected deployments of mobile location-based services under national emergency alerting and warning systems. In particular, the paper examines general public perspective of the importance of utilising the services in different types of emergency events, categorised as natural and human-caused. A survey was carried out to fulfil the requirements of the investigation. The findings clearly denoted significant differences between the mean ranks of all emergency types in the two categories, providing evidence that the importance of utilising LBS is perceived differently by the public for different emergency event types. It is expected that such validated criterion of investigation would help systems' designers to narrow down their selection of emergency event types to only those with extremely high significance to the public, hence avoiding the possibility of ending up with people opting out from the system as a consequence of being continuously bombarded by notifications for emergency events including minor ones.

1. Introduction

The number of emergencies and disasters showed an upward trend in frequency increase in recent years, both in the developed and developing countries, caused by several factors that include increased human activities in hazard-prone areas, military conflicts and climate changes [1-2].

Governments around the world have acknowledged the need to utilise all available communication channels, including mobile telecommunications networks, to counter the growing threatening potentiality of all identifiable human-caused and natural risks [3]. Location-based services (LBS) are amongst the technologies that have been exploited recently in several countries as means to communicate and disseminate public alerts and time-critical safety information to all active mobile handsets about existing or impending emergency events within geographically defined area(s) [3-5].

The widespread use of mobile handsets presents a real opportunity as an information lifeline in times of perils, especially now when people are becoming increasingly mobile in the way they communicate and acquire information relevant to their whereabouts and different daily life activities. As people tend to carry their mobile handsets with them at all times, LBS could be quite valuable addition to the current emergency alert and warning systems. The services have the potential to augment situational awareness amongst people, specifically targeting those who are not anchored at the time of an emergency to a traditional informative channel such as the TV, radio, or the internet, hence helping to avoid further casualties or damages [6].

It is reasonable to argue that any LBS solution should be flexible enough to allow support for all current and future types of emergency events and not to be only designed to support specific types requiring notification [7-8]. However, one of the main issues that may arise from such a design is that providing notifications for emergency events including minor ones have the potential to dilute responses to warnings; a case that has been recorded before in several commercial public alerting projects in the United States where individuals started to opt out as a consequence of being continuously bombarded by notifications [9-10].

Consequently, there is a need to investigate how people would rank the importance of utilising LBS in different types of emergencies, which would help designers of current and future solutions to narrow down their selection of emergency event types to only those with extremely high significance to people. However, some could reasonably argue that one particular emergency type indicating significance to some people might mean nothing to others and therefore it is improper to rank different types of emergency events according to their importance (e.g. a tsunami for people who live near the shoreline versus the people who live in an inland province). Still, these rankings would give a focus and a better acknowledgment of the emergency event types that are truly a major concern to people and offer a validated criterion that could be objectively considered in the solution's design to elicit the desired public responses to the warnings [10].

2. Research method

Around 1350 surveys were randomly distributed by hand, in March 2009, to households' mailboxes in the states of New South Wales and Tasmania. The survey included a concise introduction to give participants a principal understanding about LBS and their various applications in the domain of emergency management. Participants were asked to rank how important it is to utilise LBS solutions in 16 different emergency event types, categorised into two separate sets as natural events and human-made. Most emergency types were congregated based on the "Disasters Database" that is provided to the public by Emergency Management Australia (EMA) [11]. An adequate consideration was taken to include only the frequent types of emergencies and hazards known to Australians. Volcanos, for example, were not considered since there are no activities or occurrences of such events in Australia's recent history.

The traditional approach of surveying was chosen because it is the most resilient method to social desirability effects [12], where respondents may reply in a way they think it is more socially appropriate [13]. In addition, it is generally associated with high levels of anonymity, something that may not be completely assured or guaranteed by other methods of data collection [12, 14]. Participants were asked to return their copies to the researcher in the enclosed reply-paid envelope provided with the survey, before the 14th of April, 2009. Another two weeks were additionally given to allow for late respondents. From 1350 copies distributed, 304 were returned, yielding a 22.52% response rate. However, after excluding all unusable partial responses, 290 surveys were left for the final analysis.

2.1. Measurements and analysis approach

A three-point ranking scale was used to obtain the responses. For each emergency event type given, the weight of (1) indicated that it is not really important to provide LBS for this particular type, (2) marked somewhat important, while (3) signified extreme importance. The statistical package SPSS 15 was used to generate the descriptive statistics. The package was also employed to conduct Friedman Test, a non-parametric test alternative to the one-way repeated measures analysis of variance for multiple related samples from the same population, to assess whether or not there are differences amongst the mean ranks of each category (i.e. natural and human-made) [15]. The emergency event type with a higher mean rank value indicated a higher rating than the type with a lower mean rank.

3. Analysis results

3.1. Descriptive statistics

Subjects' data were summarised and reported in aggregated form to maintain anonymity and confidentiality of all respondents. Out of the 290 replies, 110 were females (37.9%) and 180 were males (62.1%). The sample showed that 43.1% (N=125) of the respondents were between 18 and 25 year old, 21.7% (N=63) were between 26 and 35 year old, 18.6% (N=54) were in the 35-44 age group, 12.4% (N=36) were 45-54 year old, 3.4% (N=10) were 55-64 year old, and only two people who were aged 65 or above completed the survey. The demographic and societal characteristics of the sample population are illustrated in Table 1.

Table 1: Characteristics of the sample population

Characteristic	Frequency	Percentage (%)
Gender		
Female	110	37.9
Male	180	62.1
Age		
18-25	125	43.1
26-34	63	21.7
35-44	54	18.6
45-54	36	12.4
55-64	10	3.4
65 or above	2	0.7
Education		
Still at school	7	2.4
Secondary education	48	16.6
Certificate level including skilled vocational	20	6.9
Advance diploma or diploma level	27	9.3
Bachelor degree	120	41.4
Graduate diploma or graduate certificate level	19	6.6
Postgraduate degree	49	16.9
Annual gross income		
Under \$19,999	83	28.6
\$20,000 – \$39,999	69	23.8
\$40,000 – \$59,999	54	18.6
\$60,000 – \$79,999	34	11.7
\$80,000 – \$99,999	22	7.6
\$100,000 – \$119,999	4	1.4
\$120,000 or more	21	7.2
Missing	3	1.0

3.2. Public rankings of human-caused events

Two hundred and eighty three subjects provided their responses back on this category. The analysis results denoted significant differences between the mean ranks of all human-caused emergency event types ($p < 0.001$). See Table 2. The findings revealed that terrorism acts were rated as the highest amongst all, with a mean rank of 6.24.

Table 2: The importance of utilising LBS in human-caused emergencies

Emergency Type		Mean Rank
1	Terrorism act	6.24
2	Urban fire	5.63
3	Toxic spill or chemical emission	5.60
4	Explosion	5.54
5	Major transportation incident (e.g. road closure, traffic collision, etc.)	4.95
6	Civil disturbance (e.g. riot)	4.55
7	Mining or industry incident	4.31
8	Pollution (e.g. air pollution, water pollution, smog, etc.)	4.19
9	Blackout or main power failure	3.99
Test Statistics^a		
N		283
Chi-Square		308.639
df		8
Asymp. Sig.		.000
a. Friedman Test		

3.3. Public rankings of natural events

For this category, 286 responses were obtained back. The differences in the mean rank between the various types were statistically significant with ($p < 0.001$). Bushfires and flash floods were ranked the highest with mean ranks of 4.47 and 4.23 respectively. See Table 3.

Table 3: The importance of utilising LBS in natural hazards and disasters

Emergency Type		Mean Rank
1	Bushfires	4.47
2	Flash floods	4.23
3	Tsunami or tidal waves	4.19
4	Severe weather conditions (e.g. storm surge, land gale, hail, cyclone, hurricane, torrential rain, etc.)	3.92
5	Earthquake	3.84
6	Epidemic or disease outbreak (e.g. SARS, Salmonella, Avian flu, West Nile virus, etc.)	3.84
7	Landslide or mudslide	3.51

Test Statistics ^a	
N	286
Chi-Square	102.766
df	6
Asymp. Sig.	.000
a. Friedman Test	

4. Discussion

The results evince significant differences between the mean ranks of all emergency types in the two categories (i.e. natural and human-caused), providing a statistical evidence that the importance of utilising LBS is perceived differently by the general public for different emergency event types, which supports the base argument of this paper.

In regard to the human-made emergency event types, Australians have ranked terrorism acts as the highest amongst all despite the fact that terrorism attacks are a highly distinct possibility within Australia [16]. This outcome is most likely to be the result of the continuous interest from the Australian media in worldwide terrorism attacks. It could also be the consequence of the high impact of some major terrorism attacks that took place overseas, in which Australians have either endured their horrible effects themselves, such as the case in the 2002 Bali bombings that left 88 Australians dead, or been witnesses to some of these highly destructive events such as September 11, 2001 New York attacks and July 7, 2005 London bombings. The results could also explain, or be explained by, the Australian Federal Governments' cumulated investments on counter-terrorism programs, including educational campaigns, which exceeded Aus\$10 billion since September 11, 2001 attacks, compared to around Aus\$500 million in managing the potential consequences of a large-scale natural disaster occurring in Australia [16]. People fear terrorism more than natural disasters [17]. Indeed, unlike any other event, terrorism acts are transnational phenomena that have the power to attract public attention anywhere [18].

As for the natural emergency event types, the annual frequencies of bushfires, flash floods and extreme weather conditions, particularly cyclones, in Australia might provide an answer of why these specific events had been rated amongst the top four in their category. In addition, Australia has unfortunately suffered its worst natural disaster, since the 1918 world-wide influenza (Spanish Flu strain) pandemic [11], when severe bushfires claimed the lives of more than 170 Australians in the State of Victoria in February 2009. This tragic disaster clearly explains why bushfires had the highest mean rank amongst all types of natural hazards and disasters, even when, if correctly, compared with the mean rank values of all types

of emergencies, being natural or human-caused, as seen in Table 4.

Table 4: The importance of utilising LBS in natural and human-caused emergency event types

Emergency Type		Mean Rank
1	Bushfires	10.94
2	Flash floods	10.36
3	Tsunami or tidal waves	10.30
4	Severe weather conditions	9.71
5	Terrorism act	9.65
6	Earthquake	9.49
7	Epidemic or disease outbreak	9.48
8	Landslide or mudslide	8.86
9	Urban fire	8.51
10	Toxic spill or chemical emission	8.43
11	Explosion	8.36
12	Major transportation incident	7.23
14	Civil disturbance	6.62
15	Pollution	6.07
16	Blackout or main power failure	5.76
Test Statistics ^a		
N	283	
Chi-Square	834.124	
df	15	
Asymp. Sig.	.000	
a. Friedman Test		

5. Conclusion

Utilising LBS under national emergency alerting and warning systems represent one of the most reasonable application areas where the deployment of location technology makes sense. As a feasible solution, LBS should be flexible enough to manage all current and future types of emergencies. However, one of the main issues noted before is that when providing notifications for all types of emergencies, including minor ones, individuals started to opt out from the system as a consequence of being bombarded by notices. This paper argued the need to provide the opportunity to the public to rank the importance of utilising LBS in various emergency event types. Such investigation is expected to yield those emergency types with the highest significance to people, thus help providing answers into some of the issues related to user requirements for location-based public alerting and warning systems.

The investigation was carried out using a mail survey, in which participants were asked to rank how important it is to utilise LBS in 16 different emergency event types, categorised into two separate sets as natural and man-caused. The results showed significant differences between the mean ranks of all emergency types in the two

sets with bushfires and terrorism attacks ranked the highest in their respective categories, something not totally unexpected since these two particular emergency types have high impact on Australians, perhaps, more than any other.

Finally, this paper is amongst the first to undertake the responsibility of presenting the public perspective in regard to utilising location-based services in different emergency event types. However, while the effort of this paper comes in an attempt to provide an insight into some of the issues that should be considered in the design of current and future location-based emergency systems, the authors believe that more work is needed to reach a clearer understanding and grasp of people's actual needs and requirements in such systems.

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