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# Evaluation of Mobile Applications for Disaster Responses through Personas and Scenarios

**Heejae Jung**

Kyung Hee University  
Yongin-si, Gyeonggi-do, Republic of Korea  
lydiahjung@khu.ac.kr

**Hyunggu Jung**

University of Seoul  
Seoul, Republic of Korea  
hjung@uos.ac.kr

## ABSTRACT

Disasters are constantly affecting Asia. To minimize the damage, it is important to have an immediate and effective response, which requires multiple stakeholders of the disaster scenarios to communicate. After identifying stakeholders and their needs through personas and scenarios illustrating earthquake situations, we evaluated existing mobile applications with the needs for disaster responses, earthquake in particular. The findings of this study suggest design implications for creating mobile applications to support multiple stakeholders for disaster responses.

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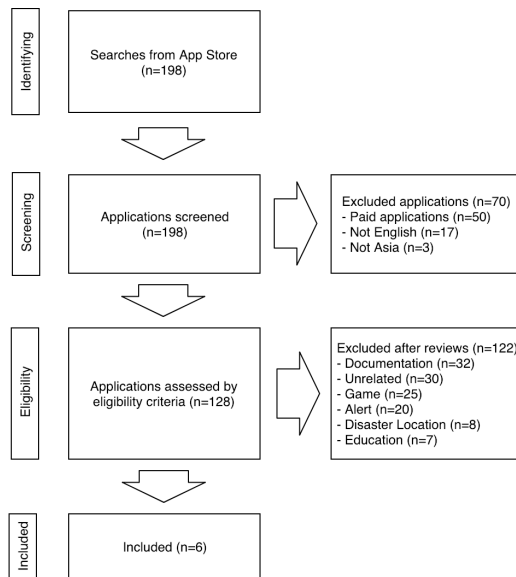
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**KEYWORDS**

disaster; earthquake; needs assessment; personas; scenarios; mobile applications; user-centered design



**Figure 1: Flow Chart of Application Selection**

**INTRODUCTION**

Over the past few years, the overall losses due to global disasters have been increasing [5]. Regions in Asia are highly more likely to have natural disasters than other regions [9]. Earthquake has the highest mortality rate and brings the most economic damages in Asia, followed up by natural disasters, such as floods and droughts [1]. The earthquake in Sichuan, China occurred in 2008 had the highest human casualties, and the earthquake off the Pacific Coast in Tohoku, Japan occurred in 2011 had the largest economic loss [3]. The frequency of earthquakes has grown in the Republic of Korea for the past few years, especially in the city of Pohang. The amount of total damage to Pohang was about 295 million dollars including 228 million dollars of direct damage and 67 million dollars of indirect damage. The city announced to invest a total of 578 million dollars in disaster recovery [6]. Although disasters resulted in such crucial damages, little is known about stakeholders and their needs during disaster situations. Among the four phases of disaster-mitigation, preparedness, response, and recovery, we focus on the response phase in earthquake scenarios. Mobile applications exist for disaster management and responses, but there still remain questions whether existing applications properly address the needs of multiple stakeholders. To reduce the gaps, we aim to answer the following research questions.

- RQ1: Who are the stakeholders during a disaster scenario?
- RQ2: What are the needs of the identified stakeholders?
- RQ3: Would the existing mobile applications meet the needs of the identified stakeholders?

**RELATED WORK**

Researchers made the effort on evaluating mobile applications designed for disaster scenarios [2, 7, 8]. In one study, Leelawat et al. [7] evaluated mobile applications to suggest factors mobile application developers should consider for creating mobile applications for disaster situations. Their focus was to review mobile applications designed for the 2011 Thailand Floods. The search strategy was to use "Thai Flood" and "Thailand Flood" as keywords in the App Store and Google Play. This study demonstrated that developers should understand user preferences and provide them with alerts or notification features for creating successful applications. Similarly, Bachmann et al. [2] systematically reviewed mobile applications for disaster medicine in Apple iTunes, using multiple terms obtained from the PubMed Medical Subject Headings Database. The findings of this review revealed that the applications need more consistent categorization. Also, they showed that applications become more crucial in scenarios involving emergency respondents as technology changes rapidly. In the other study, Mota et al. [8] showed examples of mobile applications used for post-disaster safety check. They identified mobile applications related to post-disaster risk management and evaluated them on the relevance and usability using the Internet reviews.

Persona 1. Soo Yeon, Kim		Persona 2. Ji Won, Kim	
Gender	Female	Gender	Male
Age	21	Age	23
Job	Undergraduate Student	Job	Engineer
Evacuation Experience	Yes	Evacuation Experience	No

**Figure 2: Personas of Requester A & Family of Requester A**

Persona 3. Jae Min, Lee		Persona 4. Yoon Ji, Lee	
Gender	Male	Gender	Female
Age	28	Age	26
Job	Business Consultant	Job	Graduate Student
Evacuation Experience	No	Evacuation Experience	No

**Figure 3: Personas of Requester B & Family of Requester B**

Persona 5. Tae Woo, Park	
Gender	Male
Age	32
Job	Advertising Manager
Evacuation Experience	No

**Figure 4: Persona of Helper**

Nevertheless, no prior studies identified and reviewed mobile applications to support multiple stakeholders during earthquake scenarios.

## APPROACH

We used multiple methods to answer to our three research questions.

*RQ1.* To identify stakeholders in disaster scenarios, we conducted a systematic review of the mobile applications available in the App Store. We used a keyword of "Earthquake" to search for applications that can be used during the earthquake scenarios (see Figure 1). We identified applications that meet our eligibility criteria: 1) English language, 2) designed for earthquake scenarios. According to Figure 1, we excluded 70 applications at the Screening stage because they are paid, not English supported, and/or specifically made for certain non-Asian areas. The remaining 122 applications are excluded because they do not meet our criteria, based on the needs at disaster response phase [4]. As a result, we found a total of six applications (see Figure 5-7). We identified the stakeholders by extracting the features of the application and matching them to the stakeholders who are likely to use them.

*RQ2.* Based on the stakeholders identified by the previous step, we created personas and scenarios corresponding to each stakeholder (see Figure 2-4). We focused on two scenarios. Scenario 1 represents a situation when damages to buildings and structures occurred in the middle of the magnitude 6 earthquake, while scenario 2 illustrates a post-earthquake situation in which multiple relief organizations and temporary shelters are located near the disaster site in order to help those affected. Each scenario was divided into two sub-scenarios: one involving a requester with disaster evacuation experience (i.e., Requester A) and the other without any experience (i.e., Requester B). We then extracted stakeholders' needs from the situations on the basis of personas and scenarios (see Figure 2-4 and below).

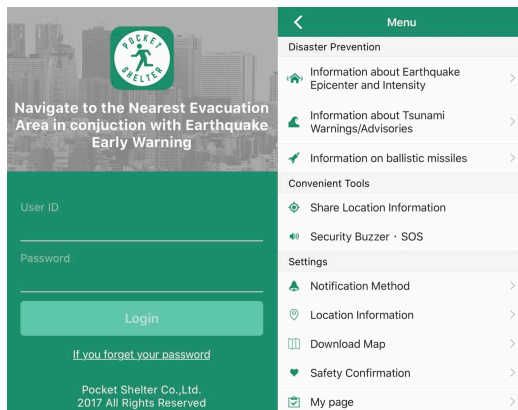
**Scenario 1 with Requester A.** From previous evacuation experience, Kim is fairly prepared for such incidents. She immediately seeks a safe routine to get to the nearest earthquake shelter possible. She is quite scared that she might get stuck in collapsed structures surrounding her. Her brother heard about the earthquake happened where Kim lives. He is worried about his sister, but he was not able to reach her. He wants to know if she is safe. Park saw that there was an earthquake near his hometown. He wants to help as much as he can to save people and recover from the earthquake. He wants to check how he can support those in need.

**Scenario 1 with Requester B.** Rescuers are trying to locate those in need. Immediate and efficient evacuation from the sites is important. Lee has never encountered any disaster situations, so he is terrified to go outside, keeping himself inside his place. He wants to know what he should do in such situations, and he also wants to see if there are emergency contact information that he

**Table 1: Identified Needs of Stakeholders in Earthquake Scenarios**

<i>Stakeholder</i>	<i>Scenario 1 with Requester A</i>	<i>Scenario 1 with Requester B</i>	<i>Scenario 2 with Requester A</i>	<i>Scenario 2 with Requester B</i>
Requester A	Share Location Information Need Map Nearby Shelter & Contact Information	NA	Location of Relief Organizations Help Information	NA
Requester B	NA	Share Location Information Disaster Evacuation Information	NA	Help Information
Family	Requester Status Requester Location	Requester Status Requester Location	Requester Status Requester Location Help Information	Requester Status Requester Location Help Information
Helper	Help Information	Help Information	Help Information Relief Organization Information	Help Information Relief Organization Information

\*NA: Not Available



**Figure 5: The Pocket Shelter application on the left is a navigation application used offline. It offers features for sightseeing in normal occasions, along with a disaster prevention mode for disaster situations. The Pocket Shelter Plus application on the right is strictly limited to Japan only. It provides the same features of Pocket Shelter with additional user account system.**

can contact to. His sister has not experienced any disaster situation as well, so she is worried about how her brother is doing. She wants to check on him and share new information that can help her

brother. Park saw that there was an earthquake near his hometown. He wants to help as much as he can to save people and recover from the earthquake. He wants to check how he can help those in need.

**Scenario 2 with Requester A.** Kim needs a safe place to stay a while. She is trying to locate temporary shelters near her and find several relief organizations working near her for relief and aid. She would like to get as many helps as possible. Her brother is relieved that Kim is safe and that she knows how to cope with the situation more than he does. Still, he tries to help his sister by providing recent relief and aid information near her. Park saw that the earthquake ceased and that relief organizations are starting to help people nearby the disaster site. He would like to know what kind of relief organizations there are and what kind of support he can send.

**Scenario 2 with Requester B.** Lee's own place has only had minor damages, but he feels unsafe by his own. He wants to see if there are temporary shelters where he can reside for a while. He also wants to know where he can get help. His sister is relieved that they are in touch, but she wants him to stay as safe as possible. She wants to provide information about relief and aid. Park saw that the earthquake ceased and that relief organizations are starting to help people nearby the disaster site. He wants to know what kinds of relief organizations there are and what kind of support he can send.

*RQ3.* A total of thirteen needs from different stakeholders was found by using personas fitting scenarios (see Figures 2-4). We then interacted with the applications manually and evaluated them with thirteen identified needs.

Table 2: Application Evaluation Matrix

Stakeholder	Need	Applications					
		Pocket Shelter	Pocket Shelter Plus	Disaster	TRI	Life Protector	T2W
Requester A	Nearby Shelter & Contact Information	✓	✓	✓	-	-	-
	Need Map	✓	✓	✓	-	-	-
	Help Information	✓	✓	-	-	-	-
	Share Location Information	-	-	✓	-	-	-
	Location of Relief Organizations	-	-	-	-	-	-
Requester B	Disaster Evacuation Information	✓	✓	-	-	-	-
	Share Location Information	-	-	✓	-	-	-
	Help Information	-	-	-	-	-	-
Family	Requester Location	✓	✓	✓	-	-	-
	Requester Status	✓	✓	-	-	-	-
	Help Information	-	-	-	-	-	-
Helper	Help Information	-	-	-	✓	-	-
	Relief Organization Information	-	-	-	✓	-	-

## FINDINGS

*RQ1.* After using the selected six mobile applications, we identified the following five types of stakeholders who would use them during a disaster scenario: requester, family members of the requester, relief organization, rescuer, and helper. We then chose three most frequently appeared: a requester, family members of the requester, and helper. A requester is someone in the disaster situation that needs help, while a helper is someone trying to help people in need in during a disaster situation.

*RQ2.* We extracted the needs for each stakeholder in each scenario (see Table 1). A family member of the requester and the helper shared needs in top categorized scenarios, Scenario 1 and 2, which corresponds to during earthquake and post-earthquake situations. Post-earthquake situations additionally needed help information for the family of the requester and relief organization information for the helper. We found that the needs for requester were different depending on the experience of the requester. Requester with experience had more specific needs and was more active compared to the inexperienced.

*RQ3.* Table 2 illustrates the evaluation matrix for the chosen applications. Help information indicates that each stakeholder wants to know information about all the helps one could get or give in Helper's case. All the identified applications were identical in that they were designed for people to

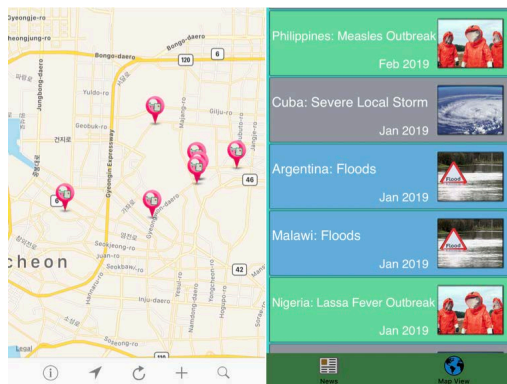
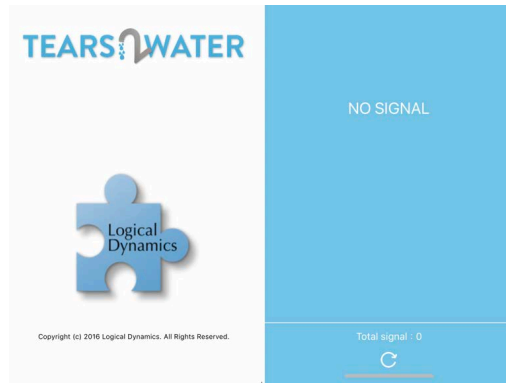


Figure 6: The Disaster application on the left enables users to send messages to family members or loved ones including location information. The Tragedy Relief Index (TRI) application on the right has features for performing blood donation and monetary donation.



**Figure 7: The Tears2Water (T2W) application on the left allows disaster relief NGOs to efficiently install water filters in order to aid the victims of natural disasters. The Life Protector application on the right fastens rescuing process by broadcasting enhanced WIFI signal when body movement and voices are detected from a collapsed building or structure.**

#### A SHORT BIO OF AUTHORS

*Heejae Jung* (lydiajhjung@khu.ac.kr) is an undergraduate student at Kyung Hee University, Republic of Korea. She is under the Department of Software Convergence, concentrating in Data Science, and the Department of Applied Science, majoring in Applied Mathematics.

*Hyunggu Jung* (hjung@uos.ac.kr) is an assistant professor of Computer Science and Engineering at the University of Seoul, Republic of Korea. His research interests include health informatics, decision-making, and social computing. His research aims to support individuals with special needs through design and engineering.

use in disaster scenarios. However, we found that each application had a different needs satisfaction ratio indicating how many identified needs were satisfied by the applications, according to our extracted needs from selected stakeholders. For example, Pocket Shelter and Pocket Shelter Plus had the highest satisfaction ratio of 46.15% each, followed by Disaster of 38.46% satisfaction ratio. T2W and Life Protector did not fit to the needs at all while TRI had a ratio of 15.38%. Through this, it was clear that each application focuses on meeting the needs of specific stakeholders, not the whole. That is, the existing mobile applications did satisfy the needs of stakeholders but lack satisfying multiple stakeholders' needs simultaneously.

#### CONCLUSION

The primary goal of this study was to investigate the existing disaster response mobile applications. We identified multiple stakeholders in disaster scenarios by reviewing selecting mobile applications for earthquakes. We then created personas and scenarios that represent earthquake situations involving the identified stakeholders. Extracted needs of the stakeholders from this process were used as metrics for evaluating the selected applications. The findings of this study revealed that no existing mobile applications addressed the needs of multiple stakeholders fully.

One of the limitations of this study is that we focused on applications supporting only English and targeting for the regions in Asia. In addition, it is possible for the theoretical settings of personas and scenarios to result in missing out some real-world factors, such as regional differences and magnitudes of the disasters. Future work still remains to understand the community of multiple stakeholders of the disaster scenarios. We plan on conducting surveys and interviews to evaluate and redesign existing mobile applications for disaster responses.

#### FUTURE IMPACT

This study can be applied as a guideline developing mobile applications for disaster responses supporting multiple stakeholders. Immediate and effective responses are crucial to disaster response and disaster management. Mobile applications can be a powerful tool as a communication platform for sufficient disaster management. With an application that satisfies multiple stakeholders at once, we can expect reductions in cost and death rates caused by disasters.

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