Introduction of a Tracking Map to a Web Application for Location Recording and Rescue Request

Shuji Nishikawa
Tokai University
s.nishikawa@utsuken.net

Osamu Uchida
Tokai University
o-uchida@tokai.ac.jp

Keisuke Utsu
Tokai University
utsukei@tokai.ac.jp

ABSTRACT

We developed a web application for location recording and rescue request using Twitter (T-Pl@ce). This application helps supported users (e.g., older adults, persons with disabilities, and children) who require support to share their location coordinates via Twitter. Supporting users (e.g., families, relatives, or neighbors) of the supported user can then check the location coordinates of the supported user when required. When the supported user needs to be rescued, he/she can post a rescue request on Twitter by pressing the "Rescue request" button on the application. This paper reports the introduction of additional functions to the application. We introduce the e-mail notification function to reliably notify a rescue request to a system administrator or rescue experts. In addition, to track the location of the supported user, we introduce a location tracking function. Then, the administrator, the rescue experts, or the supporting user can refer to the request and the location tracking page and execute the support and rescue activities.

Keywords

Location information, Rescue request, Disaster

INTRODUCTION

Large-scale disasters occur frequently in Japan. The search for missing people occasionally becomes difficult because of the lack of information regarding their locations. Many people went missing after the Great East Japan Earthquake of March 11, 2011. Although more than seven years have passed since this event, approximately 2,539 people still remain missing in the hardest-hit areas (Sankei News, 2018).

Since the Great East Japan Earthquake, social media has played an important role during and after large-scale disasters. Numerous posts (tweets) giving safety information and rescue requests were posted and shared on Twitter; this helped rescue a number of victims. In the 2016 Kumamoto earthquake, victims were rescued based on Twitter posts that requested rescue (Sankei West, 2016). Similar situations have occurred in recent disasters, such as the 2012 Hurricane Sandy and the 2017 Northern Kyushu Heavy Rain Disaster (Neppalli et al., 2016; Sato et al., 2018). In the 2016 Kumamoto Earthquake and the 2017 Northern Kyushu Heavy Rain Disaster, a hashtag "#救助" meaning #rescue was used on Twitter to request for rescue (Sato et al., 2018). To achieve the rescue based on tweets, the victim was required to post a tweet that included detailed information about his/her current location. However, the victims who were not familiar with information devices and social media had difficulty in sending their location coordinates. To enable users to easily send disaster-related information or rescue requests using smartphones, we have developed two web applications: Disaster Information Tweeting System (Kosugi et al., 2017) and Twitter-based Safety Confirmation System (Abe et al., 2017).

Besides natural disasters, the Japanese society is facing the problem of a rapidly aging population. It is common to hear of accidents involving older adults who have gone missing (The Japan Times, 2014). Such persons had difficulty in sending their information or rescue requests using existing applications, particularly during and after disasters. Several studies reported the difficulty in using the social media for elderly people (Leist, 2013; Xie et al., 2012).

Given the above background, we decided to develop an application based on the rescue potential of social media. In our application, the location coordinates of the supported users (e.g., older adults, persons with disabilities, and children) who require daily support are automatically recorded on the social media, and these users can easily send a rescue request when required. Then, an administrator and rescue experts can refer to the request and execute the support and rescue activities. To realize the application, we developed a prototype of the web application T-Pl@ce (Nishikawa et al., 2017). Using this application, the supported users could share their location coordinates periodically and automatically on Twitter. There are no skills required to operate the application for the supported users. Then, the supporting users (e.g., families, relatives, or neighbors of the supported user) can check the location coordinates whenever required. In addition, the supported user can easily use the application to send a rescue request on Twitter by pressing the "Rescue request" button.

In this paper, we introduce additional functions to improve the proposed application. To reliably notify the rescue request to a system administrator or rescue experts, we introduce an e-mail notification function. In addition, to efficiently track the supported user, we introduce a location tracking function. These functions will be helpful for assisting oneself and others in both daily life and emergency situations. Then, the administrator, the rescue experts, or the supporting user can refer to the request and the location tracking page to execute the support and rescue activities.

RELATED STUDIES AND APPLICATIONS

There are several smartphone applications that can search for the supported persons or the rescue activities for missing people. Hibeacon (INTERPRO Inc., 2018) and AirTalk (OFF Line Co., Ltd., 2018) can share a user's location with the smartphones in the vicinity of the user. Using Bluetooth technology, these applications can transmit a user's current location to the smartphones around the user. MIMAMORUME (MIMAMORUME Co., Ltd., 2018) can be used to track the movements of older adult people; it can also track school children as they go to and return from school. The system can display the location of the supported person on the map. The supported person must carry a dedicated Global Positioning System (GPS) terminal so that the supporting person can find his or her location. Moreover, using e-mail, the system can automatically notify the supporting person when the children leave school. The service uses the location information service provided by a mobile communication carrier company. Life 360 (Life 360, 2018) is an application that runs on the supported person's smartphone without using dedicated devices. The application provides an instant messaging service also. Ohno et al. and Kanazawa et al. proposed a total life support system called TLIFES (Ohno et al., 2013; Kanazawa et al., 2014). This is an integrated system to share information in the local communities. In this system, the data obtained from the GPS on the smartphones are sent to a server, and the location information is communicated to a community of participants. Matsuoka et al. proposed a system that aims to support older adults who have a tendency to wander (Matsuoka et al., 2011). The system allows the supported person to use a wearable device with a microphone for transmitting emergency signals. When the supported person moves outside a preset area, his or her location information and the sounds around him or her, which are recorded by a microphone, are sent to a server. This information is simultaneously notified to a caregiver via an e-mail. Me-MAMORIO is a service to track people who wander off because they suffer from dementia (Eisai Co., Ltd., 2016). The system uses Bluetooth tags and smartphones with dedicated applications. The persons who need to be tracked fit the tags to their personal belongings. Using the Bluetooth beacon device, the location information is sent to the server via the neighboring people who have smartphones with the application installed in them. The location information is then notified to the families of the concerned persons. This system may prevent people with dementia from going missing.

However, to provide the services for the supported person who do not have smartphones, several services using low-power wide-area (LPWA) networks have been provided recently in Japan. Liveair (LiveRidge, 2018) is a system that uses a GPS-equipped device that can communicate by LPWA. The device sends the position information of the supported person to the receiving terminal. When the supported person moves from the specific point to another specific point (e.g., from home to the school), the system notifies the smartphone of his/her family. Mima-mo-ra (Mimamora, 2018) is a system that uses a GPS-equipped wristband, which can

communicate by LPWA. In this service, the supported person wears a wristband. The battery capacity of the wristband is five years. The coverage for the systems using LPWA is still smaller than that for the systems using cellular networks.

PROPOSED APPLICATION, T-PL@CE

This section explains the operation of the proposed application and introduces additional functions.

The advantages of the proposed application are as follows. First, the proposed application uses Twitter unlike Facebook, Google+, and LINE (a famous communication application in Asia). Twitter is an open social media. Therefore, an application that uses Twitter is most helpful for mutual and public assistance. In the system proposed in previous studies (Ohno et al., 2013; Kanazawa et al., 2014), the location information of the supported users is shared with the community participants. However, using our proposed application, supported users can share their location with people of their choice and can send a rescue request whenever needed. In addition, Twitter has many daily users who are already familiar with the application. The use of Twitter may overcome the inherent problem of most existing systems—that of not being used on a daily basis. Our application can be a solution to this problem. Second, our application is a web application. Unlike a native application, the users need not download the application before using the service; therefore, the user can use the application immediately when needed. Moreover, the users do not need to update the application when it is renewed.

Operation of the proposed application

The prototype of the application was developed using PHP and JavaScript and deployed on a general rented web server. The Geolocation API (W3C, 2017) was used to obtain the location information from a user's device.

To use the application, the service provider must have an e-mail address for receiving rescue requests. In addition, the supported users must create their own Twitter account. The account should be protected (only approved followers of the account are allowed to read the timeline) to ensure privacy protection. By this protection, strangers who are not approved to follow the supported user's account are hard to find the supported user's location. We assume that the supporting user creates the supported user's Twitter account and sets it up to the supported user's smartphones. Therefore, the supported user is not required to have the skill to operate the application and Twitter. The supporting user does not need to have a Twitter account. If the supporting user has a Twitter account, he/she should, if necessary, follow the supported user's account.

The supporting user uses the application in the following manner: the supported user accesses the application on the server via a web browser. Then, the supported user presses the "Start" button on the home page shown in Figure 1. Then, he/she enters the ID and password to log into Twitter. After logging in, the supported user can see the location recording page as shown in Figure 2. When the screen appears, the location coordinates obtained by the location information service on the user's smartphone are periodically sent to the supported user's Twitter account and to the location database (DB) on T-Pl@ce system, as shown in Figures 3 (a) and (b). Figure 4 is an example of a periodical tweet. The supporting user can check the location on the Twitter timeline of the supported user by using a web browser or a Twitter client application (see Figure 3 (c)) or the location tracking page (see Figure 3 (d)). In this paper, we introduce the location tracking function. The details of the location tracking page are given in the next section. Here, the tweet includes the time when the location coordinate was obtained to exactly clarify when the data was obtained. The tweet takes a few seconds to appear on the user's timeline. Moreover, the tweet includes a hyperlink to the Google map based on the obtained location coordinates to help the supporting user.

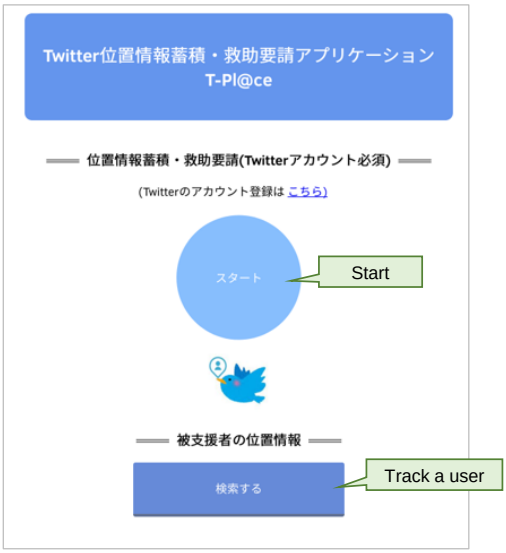

Figure 1. Home page of the proposed application

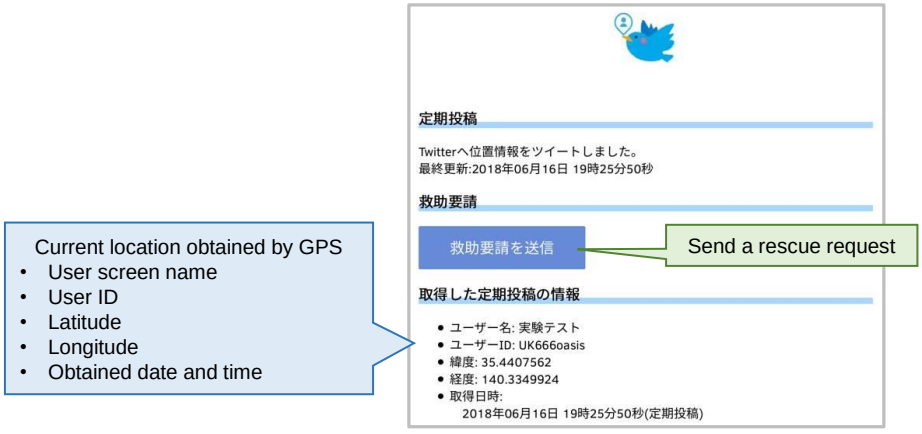

Figure 2. Location recording page of the proposed application

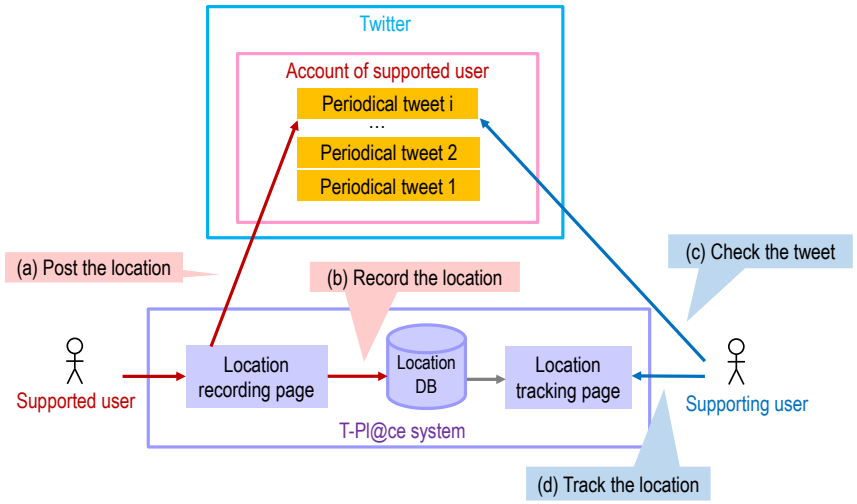

Figure 3. Outline of the location recording in the proposed application

In case of any emergency, by pressing the "Rescue request" button shown in Figure 2, the supported users can send a rescue request to their Twitter account and a location DB on the system, as shown in Figures 5 (e) and (f). Figure 6 shows an example of a rescue request posted on Twitter. The post includes the current location of the supported user and the hashtag #救助 meaning #rescue. If the supporting user favorites the supported user's Twitter account, Twitter notifies the rescue request tweet to the supported user, as shown in Figure 5 (g). The supporting user can check the rescue request tweet on Twitter, as shown in Figure 5 (h).

E-mail notification

In the earlier version of the application, the rescue request notification had been held by a @mention tweet on Twitter. However, the use of @mention tweet has been limited by Twitter. In this paper, we introduced the e-mail notification to improve the reliability of the rescue request notification. When the supported user presses the "Rescue request" button, it is sent to the administrator or the rescue experts by an e-mail, as shown in Figure 5 (i).

Figure 4. Example of a periodical tweet

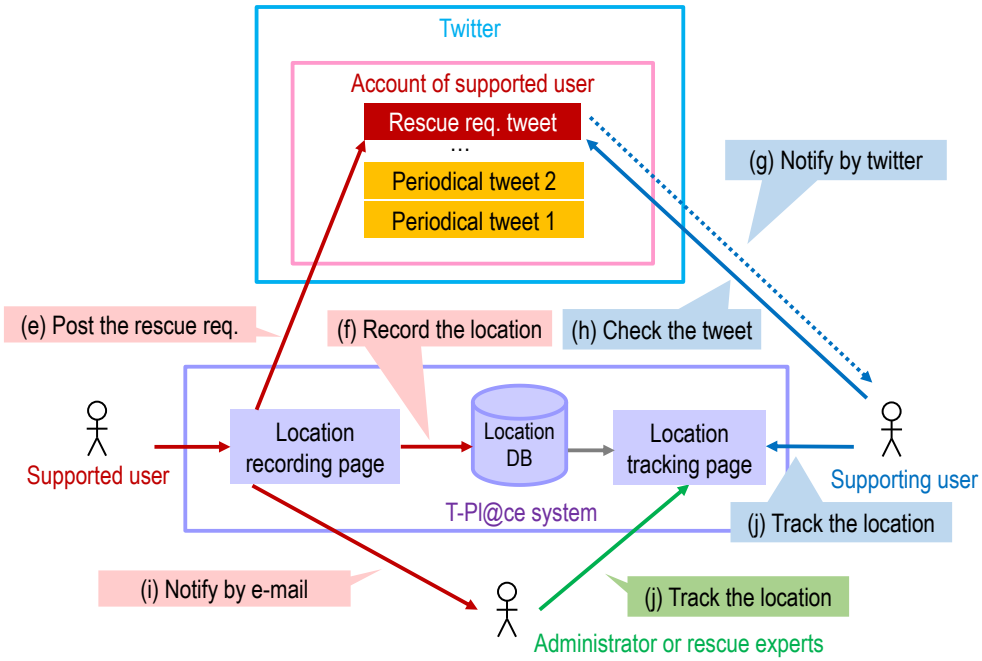

Figure 5. Outline of the rescue request in the proposed application

Figure 6. Example of the rescue request tweet

Location Tracking Function

In the earlier version of the application, to track the supported user's location, the supporting user, the administrator, and the rescue experts had to check several tweets posted by the supported user on Twitter. To enable the supporting user, the administrator, or the rescue experts to efficiently track the supported user's location, we introduced the location tracking function on Google map, which is an online map service. By pressing the "Track a User" button on the home screen (Figure 1), the user can access the location tracking page. The supporting user can track the location of the supported user by entering the Twitter ID. In addition, the administrator and the rescue experts can track the location information of all the supported users who use the application on the location tracking page. When needed or when a rescue is requested, the administrator and the rescue experts can also track a specific supported user by using the map display.

Figure 7 shows an example of the location tracking page for tracking a specific supported user. The page contains a map and table, which displays the supported user's current and previous locations, which were submitted by the supported user. Table 1 explains the meanings of the marker icons on the tracking map. By clicking the marker on the map, the user can see the Twitter screen name, the ID, the latitude, and longitude of the supported user's location, the rescue request (whether the supported user requested the rescue or not), and the date and time of the information. All this information is displayed beside the marker icon, as shown in Figure 8.

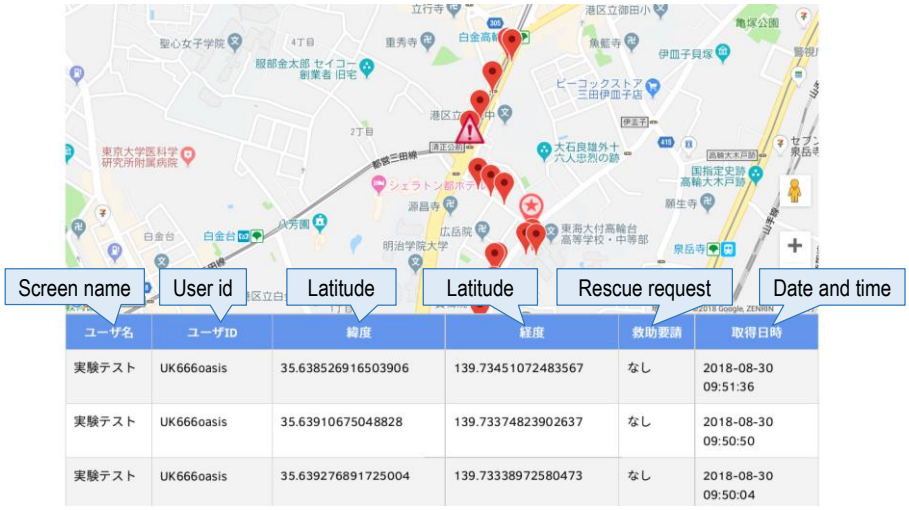

Figure 7. Example of the location tracking page for tracking the specific supported user

Table 1. Marker icons on the tracking map

Marker	Meaning
	The previous location of the supported user
	The latest location of the supported user
	The place from where the supported user sent a rescue request

Figure 8. Descriptions on the tracking map

OPERATIONAL TEST

In our previous paper, we showed the operational tests for the location recording operation (Nishikawa, 2017). This section shows an operational test of the location tracking function and the e-mail notification function of the rescue requests in addition to the location recording operation.

We used iPhone SE, produced by the Apple Inc, as a testing device. The application submits the location coordinates every 45 s by default. The reason for the default time interval is as follows. Twitter accepts up to 2400 tweets from each account per day (Twitter, 2018). Therefore, the time interval should be greater than approximately 36 s (3600 s × 24 h/2400 tweets). We, therefore, set a default time interval of 45 s. In addition, to save the battery of the supported user's device, the application checks if the supported user's position changes. If the position does not change from the position when the user had sent his or her rescue request, the time interval is set to 90 s (i.e., twice 45 s). If the position changes after increasing the time interval, the time returns to 45 s.

The test was conducted on the morning of August 30th, 2018. The distance covered was from Shirokane-Takanawa Station to Tokai University Takanawa campus building Minato city, Tokyo, Japan. The candidate walked approximately 1 km along the street wearing the device on which the application was running. For approximately five minutes, eight sets of coordinates were posted on Twitter and recorded to the location database, as shown in Table 2. The table shows the coordinates without rounding to show the obtained location coordinates accurately. In the operational test, the candidate pressed the "Rescue request" button at 9:48. Figure 9 shows an output example of the location tracking page for the candidate. As shown in the figure, the locations of the candidate were displayed on this page successfully, and we could track the movement of the candidate while walking on the street. However, the mapped icons also included errors of several meters. This was because of the errors in the positions obtained by GPS on the candidate's device. Figure 10 shows the e-mail sent to the administrator. The e-mail includes hyperlinks to the rescue request tweet and the location tracking

page on the T-Pl@ce system.

Table 2. Recorded location coordinates on the operational test

	Latitude	longitude	recorded time (hh:mm:ss)	
1	35.64231872558594	139.73397531475885	09:44:38	
2	35.642295837402344	139.73396407127427	09:45:24	
3	35.642337799072266	139.7338395556745	09:46:10	
4	35.64158248901367	139.73344177862265	09:46:56	
5	35.64094161987305	139.73310045371693	09:47:41	
6	35.64048767089844	139.73280582987178	09:48:27	
7	35.64048767089844	139.73280582987178	09:48:31	“Rescue request” button was pressed
8	35.639434814453125	139.73304705032993	09:49:17	
9	35.639276891725004	139.73338972580473	09:50:04	
10	35.63910675048828	139.73374823902637	09:50:50	
11	35.638526916503906	139.73451072483567	09:51:36	

Figure 9. Tracking map of the operational test

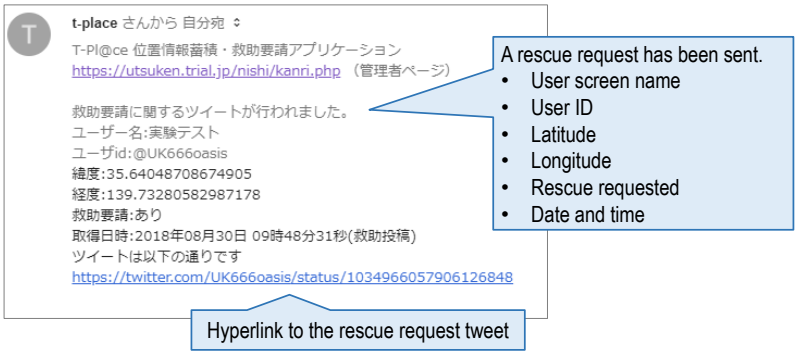

Figure 10. Rescue request mail sent to the administrator on the operational test

CONCLUSION AND FURTHER WORK

We developed a web application for location recording and rescue request using twitter (T-Pl@ce). This application assisted supported users who required daily support to share their location coordinates via Twitter. In this paper, to reliably notify the rescue request to the administrator, we introduced the e-mail notification function of the rescue request. In addition, to track the supported user efficiently, we introduced the location tracking function.

We showed the operational test of the location tracking page. As the test result, the candidate's locations were displayed and the e-mail notification of the rescue request was sent successfully. However, there are certain additional concerns, which we will investigate in our future studies. First, we need to study the privacy protection of the location tracking page. In the current prototype, the location tracking page has not been protected by a password or an authentication system. Therefore, we plan to improve the privacy aspect in the location tracking page for practical uses. Second, we plan to introduce a function to automatically detect abnormalities based on the coordinates and submit the notification on Twitter and the administrator or the rescue experts. Then, we will conduct an operational test of the application with actual users such as elderly, physically disabled people, or children. Lastly, we plan to use this application along with the Twitter-based safety confirmation system for disaster situations called T-@npi (Abe et al., 2017).

ACKNOWLEDGMENTS

This study has been supported by Grant-in-Aid for Scientific Research (KAKENHI) 17K12989, Japan Society for the Promotion of Science (JSPS).

REFERENCES

Sankei News (2018, March 11) *2539 people unknown in seven years from the Great East Japan Earthquake, evacuation life 73 thousand people*, https://www.sankei.com/affairs/news/180311/afr1803110008-n1.html

Sankei West (2016, April 14) https://www.sankei.com/west/news/160414/wst1604140105-n1.html

Neppalli, V.K., Medeiros, M.C., Caragea, C., Caragea, D., Tapia, A.H. and Halse, S. (2016). Retweetability Analysis and Prediction during Hurricane Sandy, *Proceedings of the ISCRAM 2016 Conference*.

Sato, S. and Imamura, F. (2018) An Analysis of Tweet Data Tagged with "#Rescue" in the 2017 North Kyushu Heavy Rain Disaster, *Journal of Japan Society for Natural Disaster Science*, 37, 1.

Kosugi, M., Utsu, K., Tajima, S., Tomita, M., Kajita, Y., Yamamoto Y. and Uchida, O. (2017) Improvement of Twitter-based disaster-related information sharing system, *Proceedings of the 2017 4th International Conference on Information and Communication Technologies for Disaster Management (ICT-DM).*

Abe, M., Uchida, O. and Utsu, K. (2017) Operability Improvement of Twitter-based Safety Confirmation System for Disaster Situations, *Proceedings of the 2017 International Conference on Parallel and Distributed Processing Techniques and Applications (PDPTA'17)*, 203-208.

The Japan Times (2014, May 24) *Getting past the stigma of dementia*, https://www.japantimes.co.jp/news/2014/05/24/national/media-national/getting-past-stigma-dementia/

Leist., K. A., (2013) Social media use of older adults: A Mini-Review, Gerontology 2013, 59, 378-384.

Xie, B., Watkins, I., Golbeck J. and Huang, M. (2012) Understanding and changing older adult's perceptions and learning of social media, Educational Gerontology, 38, 4, 282-296.

Nishikawa, S., Ohtsuka, Y., Uchida, O., Ishii, H. and Utsu, K. (2017) Web Application for Location Recording and Rescue Request Using Twitter", *Proceedings of the 2017 International Conference on Parallel and Distributed Processing Techniques and Applications (PDPTA'17)*, 209-215.

INTERPRO Inc. (2016, January 14) *Hibeacon*, http://www.hibeacon.jp/

OFF LINE Co., Ltd. (2018, September 6) *AirTalk*, http://airtalk.off-line.co.jp/en/

Life 360 (2018, September 6) Life 360, https://www.life360.com/

Ohno, Y., Teshima K., Kato, D., Suzuki, H., Asahi, K., Yamamoto, O. and Watanabe, A. (2013) A Proposal of a Method for Detecting Wandering Behavior and Its Implementation Using TLIFES, *IPSJ SIG Technical Report*, 2013-GN-86, 12.

Kanazawa, A., Suzuki, H., Asahi, K. and Watanabe, A. (2014) Proposal of Safety of Confirmation System in the Disaster Situations using TLIFES, *IPSJ SIG Technical Report*, 2014-MBL-72, 3.

Matsuoka., S., Ogawa, H., Maki, H., Yonezawa, Y. and Caldwell W. (2011) A new safety support system for wandering elderly persons, *33rd Annual International Conference of the IEEE EMBS*, 5232-5235.

Eisai Co., Ltd (2016, August 1) http://www.eisai.co.jp/news/news201656.html

Live Ridge (2016, November 17) *LiveAir*, https://www.headwaters.co.jp/news/LiveAir.html

LiveAir (2018, September 6) *LiveRidge*, https://liveair.liveridge.com

Mimamora (2018, September 6) *Mima-mo-ra*, http://www.mimamora.com/

W3C (2018, August 11) *Geolocation API Specification*, https://dev.w3.org/geo/api/spec-source.html

Twitter (2018, September 1) *About Twitter limits, Twitter Help Center*, https://help.twitter.com/en/rules-and-policies/twitter-limits