A Real-Time Disaster-Related Information Sharing System Based on the Utilization of Twitter

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***Abstract*—In order to minimize the damage in case of a disaster, it is important to collect and spread accurate information quickly. Therefore, utilizing Twitter at the time of accidents has been gaining attention. In this paper, we propose a real-time disaster-related information sharing system based on the utilization of Twitter. The proposed system consists of two functions, the one is a disaster-related information tweeting function that automatically attaches user's accurate current geo-location information (address) and the hashtag of the form "#(municipality name) disaster," and the other is a disaster-related information mapping function that plots neighboring disaster-related tweets on a map in real time. We implemented the system on a linux server and conducted a verification experiment. The results of the experiment verify the usefulness of the proposed system.**

Keywords–Twitter, tweet mapping; disaster-related information; disaster mitigation.

I. INTRODUCTION

In order to minimize the damage in case of a disaster, it is important to collect and spread accurate information quickly. Therefore, utilizing Twitter at the time of accidents has been gaining attention. The primary reasons for this are that Twitter is a social media having the characteristics of high immediacy, sharing information is very easy using Twitter, and the number of Twitter users is very large. In recent large scale natural disasters, such as the Grate East Japan Earthquake occurred in 2011, Hurricane Sandy, a Category 3 Superstorm which hit the U. S. East Coast in 2012, and Typhoon Haiyan which is called Typhoon Yolanda in the Philippines and caused severe damage to the islands of Leyte in 2013, Twitter was utilized as a communication tool by many people [1][2]. Due to the reasons mentioned above, lots of Japanese national and local governmental agencies have taken a great deal of utilizing Twitter in order to collect and distribute disaster-related information in recent years. For example, in Wako City, Saitama Prefecture, Japan, the government decided that the hashtag "#和光市災害" ("和光市" means Wako City and "災害" means disaster) is used as an official hashtag for reporting disaster situations in Wako City and conducted a disaster drill in order that citizens may get familiar with using this hashtag. Using the hashtag of the form "# (municipality name) disaster" has been spreading to other municipalities in Japan.

By the way, in order to optimize the utilization of disaster-related tweets in case of disasters, it is desirable that these tweets are geo-referenced accurately, that is, have geotags (longitude and latitude coordinates information). This is because geo-referenced tweets can be plotted on a map automatically, and both governmental agencies and disaster victims can obtain desired information by taking advantage of this map easily and promptly. However, it is well known that the percentage of Twitter users who permit the use of location services on Twitter is small, and then the ratio of geotagged tweets is quite small. For example, Cheng et al. found that only 0.42% of the tweets in their dataset were geotagged [3]. If tweets contain some geo-related information, such as building name or street address, it may be possible that obtaining longitude and latitude coordinates information by applying geoparsing technique [4][5] and geocoding. However, it is impossible to identify the location from tweet text by geoparsing completely because, for example, there are a dozen of "central park" all over the world.

Moreover, considering the active utilization of tweets posted during disasters, these tweets should contain appropriate hashtags. During past disasters, the number of tweets increased dramatically, then hashtags played an important role in information retrieving from the stupendous tweets [6]. For example, if we access https://twitter.com/search?q=%23earthquake, we can obtain tweets that contain the hashtag "#earthquake."

In this study, based on these backgrounds, we have implemented a real-time disaster-related information sharing system utilizing Twitter that supports self-, mutual-, and public-help at the occurrence of a disaster (Figure 1 shows the top page of the proposed system). The system consists of the following two functions:

(1) a disaster-related information tweeting function that automatically attaches both the user's current geo-location information (address) and the hashtag of the form "#(市区町村名) 災害" (that means #(municipality name) disaster), and
(2) a disaster information mapping function that plots tweets posted using the function (1) on a map.

In this paper, we describe the outline of the proposed

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Figure 1. Top page of the proposed system

system, and report the results of the verification experiment that was conducted in June 2015.

II. Utilization of Twitter in Case of Disaster

In recent catastrophic natural disasters, Twitter was widely used for communication tool [1]. For example, it is widely known that during the Great East Japan Earthquake occurred on March 11, 2011, thousands of people took advantage of Twitter to retrieve information on the tsunami, shelter, the state of public transportation services, and so on [2][7][8][9][10]. More than 20 million tweets about Hurricane Sandy were posted between Oct. 27 and Nov. 1, 2012 [11]. Over a quarter-million tweets were posted during the first 72 houors after Typhoon Haiyan destroyed large areas of the Philippines and crisis map was made with the aid of crowd sourcing [1][12]. When a flood disaster caused by a heavy rainfall was occurred on September 10, 2015, in Joso City, Japan, a victim who posted a tweet with address for a rescue request was saved by a rescue squad.

III. Real-Time Disaster-Related Information Sharing System

A. Disaster-Related Information Tweeting Function

A disaster-related information tweeting function was implemented as a web-based application on a linux server using PHP and JavaScript (Figure 2). This function has the following features:

(1) Tweets are posted as tweets from the user's own Twitter account (Twitter authentication is conducted at the start of the use of the function).

(2) Information of the user's current geo-location information (the longitude and latitude coordinates) is acquired by utilizing location specification functions, such as the Global Positioning System (GPS), and based on the acquired location information, both address of the user's current location and a hashtag for disaster reports of the form "#(市区町村名) 災害" (#(municipality name) disaster) is automatically attached to the tweet. In the case where the user requires rescue, the hashtag to be attached becomes

Figure 2. Disaster-related information tweeting function

Figure 3. Selection of the type of the hashtag to be attached and whether the user attaches a photo or not

of the form "#(市区町村名) 災害_要救援" ("要救援" means rescue requirement (Figure 3).

(3) If the user enable location services on Twitter, the tweet is geotagged.

(4) An image can be attached (Figure 3).

Both address, which is determined by reverse geocoding (Yahoo! Japan Developer Network, Yahoo! Reverse Geocoder API [13] is used in this study) the location (the longitude and latitude) acquired by W3C Geolocation API [14], and hashtag for disaster reports are automatically attached to tweets. For example, the acquired location information is that the latitude and longitude are 35.361743 north and 139.273691 east, respectively, the address of the user's current location is determined as "神奈川県平塚市北金目 4 丁目 1" (4-1 Kitakaname, Hiratsuka City, Kanagawa Prefecture, Japan) and the hashtag is determined as "#平塚市災害" (#Hiratsuka City disaster) (if relief is need, it becomes "#平塚市災害_要救援" (#Hiratsuka City disaster rescue requirement)). This function

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Figure 4. An example tweet posted by the proposed system

allows the user to attach images stored in their device. Users also can take a photos to be attached when they post tweets if their devices are smartphones or tablet PCs. The application uses Twitter API [15] to post texts and images. The maximum file size of the image that can be posted by Twitter API is about 3MB. Therefore, the application shrinks the file size of the image to be posted by decreasing the resolution of it before posting. Figure 4 shows an example Tweet posted by the proposed disaster information tweeting function. As you can see from the figure, the address of the current location “神奈川県平塚市北金目 4 丁目 1” is written at the beginning of the tweet and the hashtag “#平塚市災害” corresponding to the current location is attached.

B. Disaster-Related Information Mapping Function

The function to plot tweets posted using the disaster-related information tweeting function stated in the previous subsection, that is, tweets that are containing hashtags “#(市区町村名) 災害” (#(municipality name) disaster) or “#(市区町村名) 災害_要救援” (#(municipality name) disaster _ rescue requirement) on a map is implemented as a web-based application on the linux server using PHP and JavaScript (Figure 5). This application has the following features:

(1) It is available for a person without any twitter account to use.

(2) It identifies the municipality name from the user’s current location information (longitude and latitude) and displays tweets containing the municipality name in the hashtag on a map. For example, if the user’s current location is 平塚市 (Hiratsuka City), tweets with “#平塚市災害” (#Hiratsuka CIty Disaster) or “#平塚市災害_要救援” (#Hiratsuka CIty Disaster _ rescue requirement) are pinned on the map.

(3) Tweets with geotags are mapped by using the latitude and longitude. Tweets without geotags are mapped by geocoding the address written at the head of the tweet (Yahoo! Japan Developer Network, Yahoo! Geocoder API [16] is used in this study).

(4) The shape and/or color of the icon that is used to indicate the position of the tweet change depending on the type of the attached hashtag (whether it is the rescue requirement hashtag or not) and whether an image is attached or not (Table 1).

(5) The places of shelters within 2km from the current location of the user are displayed on the map. If user click (tap) an icon indicating a shelter, the shortest route from the current location of the user to the shelter is displayed by using Yahoo! Japan route map API [17] (Figure 6).

(6) If the municipal government of the current location of the user has an official Twitter account, the latest 10 Tweets of the account will be also shown.

Figure 5. Disaster-related information mapping function

Using this function, we can get neighboring disaster-related information in nearly real time easily. We believe that the function is useful both governmental agencies and disaster victims, that is, supports self-, mutual-, and public-help at the occurrence of a disaster.

IV. VERIFICATION EXPERIMENT

From 10:00 am to 4:00 pm, June 3, 2015, we conducted a verification experiment jointly with “The Study Group on Collection and Sharing of Disaster Volunteer Information Utilizing ICT, Kanagawa Prefectural Activity Support Center.” There were 41 participants. The participants tweeted 217 Tweets in all. Generally, the system operated well and many of participants expressed their impression that by using the proposed system they were able to post tweets with address of their location and the corresponding hashtag of the form “#(市区町村名) 災害” (#(municipality name) disaster) very easily. However, the following issues were noticed:

(1) When the file size of the attached image was large, the uploading time was long depending on the connection. It sometime caused time-out error of the system.

(2) When it was used indoors, geotagging feature was inaccurate and the address attached to the tweet deviated from the user’s actual address.

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TABLE I. ICONS FOR TWEET PLOTTING

icon	image	rescue requirement	geotag
			✓
		✓	✓
		✓	
	✓		✓
	✓		
	✓	✓	✓
	✓	✓	

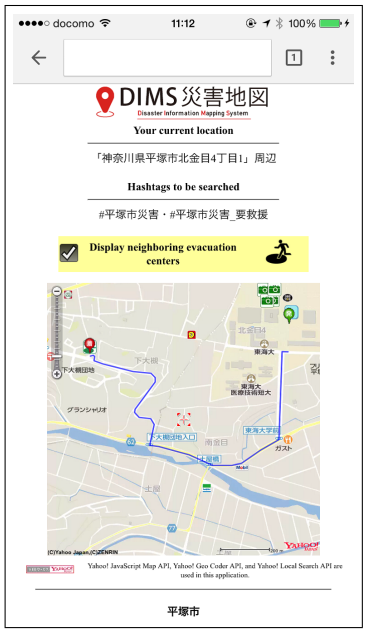

Figure 6. An example of displaying the shortest route from the current location of the user to the shelter the user selected

To solve the problem (1), we planned incorporating a feature that will reduce the file size of the image to be attached on the client-side device. For the problem (2), it is difficult to find a fundamental solution. However, we would like to consider that if the deviation estimated by the value of the accuracy obtained by W3C Geolocation API is large, only municipality name will be attached in the tweet.

V. CONCLUSION AND FUTURE WORK

We implemented a real-time disaster-related information sharing system with two functions: a disaster-related information tweeting function and a disaster-related information mapping function, and moreover conducted verification experiment. By using the proposed system, users can post disaster related tweets with geo-location information (address) and the corresponding hashtag of the form "#(市区町村名) 災害" (#(municipality name) disaster) easily even if they do not now where they are. In the future, we will try to improve the system by realizing features such as, for example, automatic useful tweets extraction [18] and tweet classification according to the contents of tweets, aggregating similar tweets, and the personalization of the tweet map according to the users' attributes, as well as improving and fixing the issues revealed by the verification experiment. The proposed system can be basically used only in Japan. Therefore, we will try to extend the system to so as to be used throughout the world.

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