5W-04

A Proposal of Method to Avoid Dangerous Routes in Emergency Cases

Philip Hamoui[†1] Kei Hiroi[†2] Katsuhiko Kaji[†1] Nobuo Kawaguchi[†1,2]

[†1] Graduate School of Engineering, Nagoya University

[†2] Institute of Innovation for Future Society, Nagoya University

1. Introduction

For the last three years, many Syrian cities have been witnessing a series of dangerous events related to the conflict ongoing there. Aleppo City experienced 150 emergency cases happened in the following numbers during 2 months (from November to December of 2014); 32 clashes, 21 missiles, 14 explosions, 41 shells and 42 air force attacks. Volunteering organizations and official bodies that are related to respond to such events, e.g. fire departments, hospitals and Syrian Arab Red Crescent (SARC), have faced a lot of problems and dangers reaching the desired areas. Many ambulances got bombed and a lot of volunteers lost their lives on the ways to the affected areas.

The SNS has been used frequently to publish news about dangerous events, like bombings or shells falling. In dealing with such cases, emergency vehicles like fire engines or ambulances should be dispatched to the affected area, using the shortest and safest routes.

However, the shortest ways between the source point and destination could not be safe, causing the problem of finding a route that is both safe and short. In this research we discuss an enhancing Dijkstra algorithm to find the optimal route that avoids the risky areas depending on the information obtained from the SNS.

2. Method to Avoid Dangerous Routes

2.1. System Architecture

The Figure 1 shows the general structure of the system. We suppose that the information about an emergency event is posted on the social network service. On the other hand, there is a provider of a rescue service (e.g. medical center), which needs to benefit from the information on the SNS, in order to offer the proper service at the proper time, using the proper route.

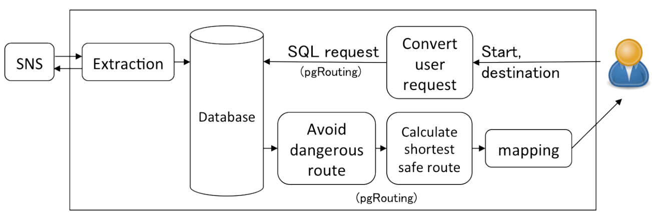

Figure 1: System Structure

The user of this system (who offers the rescue service to the casualties) initiates the request of the route to the location of the event, and this request is converted into an SQL request from the database. On the other hand, the data would be extracted from the social media, and the necessary information is filtered. This information would be stored in a database, in order to be used later to avoid the dangerous area, and estimate the safest route, and later the route would be mapped to the user's device

2.2. Extracting Emergency Event Information from SNS

At the time of the emergency events, a lot of related information flows on the social networks, e.g. Facebook and twitter. This information is posted either by individuals who have heard or witnessed the event, or by specialized news networks through their reporters around the event area. In our study we depended on one of these local news networks, which has been used as a credible source of local news.

Even in this case, not all the news posted on the page is related to (emergency) cases, because some news could be related to normal daily life events. We extracted 1000 posts and filtered the posts related to 150 emergency cases.

The available extraction tools could offer the functionality of extracting wide range of information, starting from the most direct information viewable by normal users, e.g. the post itself, the time of the post, the number of people liked this post, etc., to more unobvious information to the public readers, e.g. the link of the post, the post id, etc.

In order to define the emergency event and respond to it properly, we need to extract specific information, which are: The location of the event, the time of the occurrence, and the current situation at the location. The occurrence time of the event is approximated, since it is assumed to be slightly different from the real time, and in this case is considered equal to the time of the post on the social media network.

We extracted both location and current situation, from the post itself on the social network, by depending on filtering specific words from the post, which reflect the location and the type of the event.

For the purpose of extraction, we used a Facebook application named Netvizz to extract a number of posts from the news page during a specified time, and filtered the posts containing relevant words to the events.

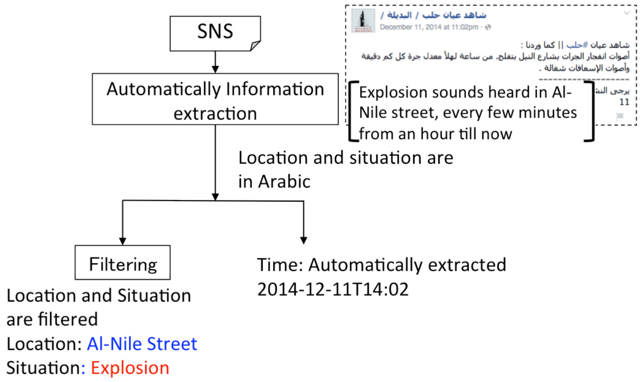

Figure 2: Information Extraction

Figure 2 summarizes the process of extracting the information from the Facebook post. Time of occurrence is obtained automatically, while the location and situation are filtered from the post itself.

We should mention here that since the research is concerned about the situation in Syria, most of the social networks use Arabic language. It is time consuming to translate literally the extracted posts, and automatic translating machines are not accurate enough, we have chosen specific 5 words that are repeated frequently and translated them.

2.3. Routing the Emergency Vehicle to Affected Area

(1) (Showing/mapping) a sample of the events on a small area

The first step of the routing is to clarify the dangerous areas on the way to the desired destination. To achieve this purpose we depend on the extracted information from the previous stage, and mapping the locations of the events using the Open Street Map (OSM). We made a table of the names of areas in Aleppo City and the coordinates represent them. The mapped places represent the areas affected and the degree of dangerousness of each event.

(2) Routing using Dijkstra algorithm

For the purpose of routing we used the pgRouting library. It includes the Dijkstra algorithm, which is one of the algorithms that work on finding the shortest route between two points.

The pgRouting deals with maps as a graph consisted of nodes and edges. The edge is the connection between two nodes, which represents a route in reality. In the case of emergencies, we denote the affected area by its center. The suggested route should avoid the affected areas as final goal.

The classical Dijkstra algorithm considers the lengths of edges/routes as weights in order to calculate the shortest route. However, we suggested adding another factor to the weighting process to be taken into consideration, which the dangerousness of route.

Figure 3 shows the difference in applying the classical Dijkstra algorithm and the edited Dijkstra algorithm. The classical Dijkstra algorithm calculates the shortest path by using the route, which goes through the dangerous area.

The circle in the figure represents the diameter of the dangerous area, which is in turn represents the degree of dangerousness. This degree of dangerousness varies according to the situation. The routes are weighted according to the event, and basically depending on the description of the event extracted from the SNS. The emergency cases are assigned weights from 1 to 5, with 1 is the minimum dangerous (shell case) and 5 is the maximum (air force attack). According to the extracted data, the average dangerousness area for cases range as following (shell: 50m, explosion: 100m, clashes: 500m, missile: 1km, air for attack 3km). The proposed algorithm calculates the shortest route except the route, which goes through the circle.

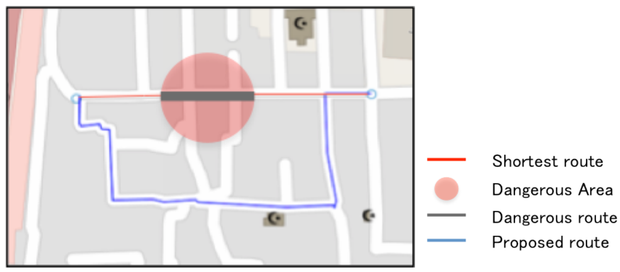

Figure 3: Comparison between routes before and after the edition of Dijkstra

3. Future Work

The current work tried to combine the information extracted from the social with previously known geographical information, in order to present safest routes for emergency vehicles in cases of emergencies. The study considered statistical case, and the processes of extraction and routing are done in separate ways. For a practical case in real life, it is recommended to take into consideration the dynamically changing information and updating it.

References

[1] Rieder, Bernhard. "Studying Facebook via data extraction: the Netvizz application." *Proceedings of the 5th Annual ACM Web Science Conference*. ACM, 2013.

[2] Kai, Ni, Zhang Yao-ting, and Ma Yue-peng. "Shortest Path Analysis Based on Dijkstra's Algorithm in Emergency Response System." *TELKOMNIKA Indonesian Journal of Electrical Engineering* 12.5 (2014): 3476-3482.

[3] Choosumrong, Sittichai, Venkatesh Raghavan and Nicolas Bozon. "Multi-Criteria Emergency Route Planning Based on Analytical Hierarchy Process and pgRouting." *Geoinformatics* vol.23, no.4, pp.159-167 (2012)

[4] Mali, Varsha, Madhuri Rao and S.S Mantha. "Enhanced Routing in Disaster Management based on GIS." *International Conference on Intuitive Systems & Solutions* (2012)

[5] Syrian Arab Red Crescent: http://www.sarc.sy/home.php