DISAster-information ANAlyzer (DISAANA) for SNS
— *Report on demonstration experiments in Miyazaki prefecture* —

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1. Introduction

At the National Institute of Information and Communications Technology (NICT), we are developing a disaster-resilient SNS information analysis system called DISAster-information ANAlyzer (DISAANA), which is publicly available on a trial basis at http://disaana.jp (Japanese only). Following the Great East Japan Earthquake, although useful disaster-related information was posted on Twitter and other social networking services (SNSs), people did not have the analysis and search means needed to use this information, so it was not easy for them to obtain the information they needed. At NICT, we have therefore been researching and developing systems that rapidly analyze disaster-related information posted to these SNSs in order to facilitate the provision of useful information not only to people who have been directly affected by the disaster but also to people involved in restoration and rescue efforts. One result of this work is DISAANA.

This article presents an overview of DISAANA, and reports on demonstration experiments performed in Miyazaki prefecture with local cooperation.

2. Overview of DISAANA

In its present experimental form, DISAANA is a question answering system that analyzes in real time the tweets that are posted on Twitter, and when a simple question is input, it instantly extracts and presents answer candidates from up to four days of tweets including the current date. It can be used not only on PCs, but also on smart phones and tablets.

Unlike conventional systems that provide information requested based on keyword searches and the like, DISAANA automatically extracts response candidates when a question is input.

There are a number of issues with searching in this sort of question answering format. One is that people use a wide variety of different expressions to say more or less the same thing, so searches can fail due to differences in how the questions are expressed. Another is that there are also a wide variety of expressions used to delimit the locations referred to in messages, and these may not be searched as intended.

DISAANA solves the first problem using a paraphrase database, created by automatically extracting paraphrases from hundreds of millions of web pages. Using approximately 300 million pieces of knowledge such as *"there is a shortage of X, which can be reworded as there is not enough X,"* the search is extended when producing response candidates. The second problem can be solved by preparing a database of place names from information on approximately 3.4 million addresses and place names so that place names can be dealt with properly. Furthermore, each entry in the place name database is associated with latitude and longitude information that can be used to show the positions of candidate locations on a map at high speed. In general, most SNSs allow the attachment of GPS information showing the sender's location, but such features are hardly ever used due to privacy concerns. Therefore in DISAANA, instead of using GPS information, the message text is analyzed to identify the location and display it on a map.

Following the Great East Japan Earthquake, problems were caused by various false rumors that were spread around on SNSs. DISAANA deals with false rumors by not only retrieving response candidates but also retrieving response candidates from contradictory messages. Contradictory tweets are shown separately, simplifying the determination of whether the selected response candidate tweets are false rumors.

3. Demonstration experiments in Miyazaki Prefecture

With the cooperation of Miyazaki prefecture, we used DISAANA to perform demonstration experiments as described below.

Miyazaki prefecture is notorious for typhoons, and when typhoons approach the area, they are liable to cause flooding and landslides due to its geographical and natural characteristics. In recent years, a series of major landslides have been caused by typhoons and intense rainfall in 1997, 2004 and 2005, leaving deep scars in all parts of the prefecture. The possibility of a major earthquake occurring in the Nankai trough is also a cause for concern. Disaster prevention therefore has a high profile throughout the prefecture, and there are also efforts being made to cultivate disaster prevention experts.

When these disaster prevention experts and ordinary citizens with a high level of disaster awareness provide disaster-related information to SNSs, this information is analyzed by DISAANA, and is verified through disaster training as to whether or not it is useful to local government when making decisions about disaster measures.

An overview of the demonstration experiments is presented below.

(1) The test subjects (ordinary citizens and disaster prevention experts) are free to post messages on a bulletin board that mimics SNS. These messages describe the state of damage that is imagined to occur under the circumstances in which the test subjects are placed.

(2) DISAANA can provide disaster-related information through question responses by analyzing each submission in real time.

(3) The test subjects actually enter questions to check whether or not DISAANA can extract response candidates from their own writings.

(4) At the city hall's disaster response unit, the decisions to take steps such as issuing evacuation orders and launching rescue efforts are based not only on ordinary disaster information such as weather information and river water levels, but also on disaster-related information from citizens who are able to use DISAANA.

Demonstration experiments took place in the cities of Nobeoka (18th January 2015) and Miyazaki (7th February 2015) with a total of 115 test subjects and 15 local government officials who underwent training for five and a half hours. Over 4,400 messages were written, and DISAANA was able to answer over 1,760 questions. The test subjects were ordinary residents of Nobeoka and Miyazaki aged 18 and over (including those with disaster prevention qualifications). The test subjects accessed DISAANA through tablet terminals or notebook PCs provided by NICT to post messages on a bulletin board. The city hall officials at the disaster response unit all used notebook PCs. All the test subjects were gathered in a conference hall, and the test was started after the operating methods had been described for about two hours. The city hall officials in the disaster response unit were also given a similar description for about 2 hours, and performed the role of a disaster response unit in a separate room away from the test subjects. Figure 1 shows the disaster response unit in the demonstration experiments.

In this experiment, one person was designated as a controller, and was trained to convey the damage situation to the test subjects and disaster response unit members at various times during the test.

■ Figure 1: disaster response unit in the demonstration experiments

In other words, the rough situation was explained each time before the start of the experiment, but specific details such as the damage situation or changes in the weather (e.g., the duration of rainfall or the occurrence of tornadoes) were conveyed to the test subjects and the disaster response unit by the controller on an ad hoc basis. Under the given circumstances, the test subjects were relatively free to write messages to the bulletin board about the envisaged damage. Meanwhile, at the disaster response unit, DISAANA was used to check the disaster situation and coordinate the disaster response. In cases where there was insufficient information for a disaster response, the bulletin board could be used to obtain additional information.

After the test, questionnaires were filled in by the city hall officials in the disaster response unit, and by the test subjects playing the role of ordinary citizens. The test subjects described their expectations of DISAANA and suggested various improvements. The city hall officials commented that although the system was useful for disaster responses, there were valuable improvements that should be made from the viewpoint of putting disaster responses into practice. A number of these suggested improvements are reflected in the latest experimental release of DISAANA. Concerns were also raised about how to deal with the authenticity of information obtained in the tests.

4. Summary

This article has introduced DISAANA being developed by NICT and has discussed the demonstration experiments performed in Miyazaki prefecture. In the demonstration experiments, DISAANA was used for disaster response under conditions very close to reality, enabling us to clarify any issues, etc. It is also considered that DISAANA was able to fully demonstrate the possibility of providing information that is useful for decision-making in disaster response operations. In the future, we intend to improve the basic performance of DISAANA, expand its capabilities so that multiple organizations such as local governments and NPOs can respond to disasters efficiently by cooperating and collaborating with each other, and continue with the development of public tests.