Disaster-prevention Initiatives using AI and Related Information on SNS

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1. Introduction

Since the 2011 Tohoku Earthquake the value of social media and SNS in particular, has been widely recognized. The ability for anyone to send information easily in real-time was shown to be useful for disaster response, but it is also widely recognized that since SNS are quite anonymous, it is also easy to spread erroneous information and cause confusion in society. Seeing the need to use such disaster-related information on SNS despite such qualities, the National Institute of Information and Communication Technology (NICT) began public trials in April 2015, of the DISAster-information ANAlyzer (DISAANA) system, which analyzes disaster SNS data on Twitter, and in October 2016, of the Disaster-information SUMMarizer (D-SUMM) system, which summarizes the state of disaster. These are being used in disaster preparedness drills by local governments and in real disasters, to verify the technology, and support further, ongoing R&D. This article reviews these two systems, how they have been used, and gives an overview of a system called "SOCial dynamics Observation and victims support Dialogue Agent platform for disaster management" (SOCDA) and related initiatives. SOCDA is a chatbot for disaster management intended to resolve problems identified in use of the earlier two systems and is the result of R&D that began in 2018, as a second-term project of the Cabinet Office's Strategic Innovation Program (SIP).

2. Twitter analysis with DISAANA and D-SUMM

Simply put, DISAANA is a question answering system. Question answering is a technology that selects answers to questions from some body of knowledge (usually a large volume of text such as an encyclopedia). Questions could be of various types: Who, What, Where, When, Why, or How; but DISAANA emphasizes understanding what happened and where in a disaster, so the focus is on "What" and "Where" questions. We have a history of R&D on such Q&A technology, and already provide trial access to a Q&A system on the WISDOM X Web page (https://wisdom-nict.jp/). DISAANA can be considered as applying some of the technology used for WISDOM X to Twitter, extending it to process place names appropriately. From the beginning of R&D on DISAANA, we described the prototype system to relevant staff at local governments and asked them about difficulties in gathering information. They pointed out that even thinking of questions and entering them can be difficult, and they did not have time to carefully check all the Q&A results, so they needed a way to comprehend what disaster-related information was on the SNS, in a compact and user-friendly form. In parallel with DISAANA R&D, there was also R&D to automatically extract disaster-related information found on SNS, and we accelerated this work. Since 2014, we received support from the Cabinet Office's Strategic Innovation Project (SIP) for R&D on D-SUMM, a system that automatically extracts disaster-related information from SNS and from it, summarizes disaster conditions in a compact and user-friendly form. Trial operation of the system began in October, 2016. Details of these two systems can be found in references at the end of this article.

3. Bi-directional communication on LINE with SOCDA

Twitter and other SNS enable anyone to post information easily in real-time, immediately sharing conditions in far-away places with photos and videos, so they hold great promise as useful tools during disasters. On the other hand, a person posting disaster information on Twitter and the like can post whatever they want, so the information will not necessarily be useful in disaster response efforts. Furthermore, even if a person is able to post their distress situation on a SNS, and someone at a disaster-response facility sees it and is able to provide information that is useful for the original poster, human resources are limited in times of disaster, and it would not be possible to respond to all such posts. This prompted the idea of developing an AI that could autonomously gather such information and distribute information appropriately, instead of a person. Starting in FY2018, we received Cabinet Office second-term SIP support and began R&D on the SOCDA chatbot for disaster management. R&D on SOCDA is being conducted jointly with the National Research Institute for Earth Science and Disaster Resilience (NIED) and Weathernews Inc. We also collaborated with LINE Corp. and the Japan Institute of Law and Information Systems (JILIS) for trials, operation and to study the system and other aspects of implementation in society.

SOCDA means Dialogue Agent platform for disaster management, and it is a platform for collecting and distributing disaster-related information through bi-directional communication, mainly with text interaction on SNS. Broadly speaking, SOCDA is not intended as a platform for a specific SNS, but currently we are collaborating with LINE Corporation to develop a chatbot program operating on the LINE SNS, together with various back-end programs, so for ordinary users accessing it from a LINE account, SOCDA can be more narrowly defined as a chatbot program on LINE.

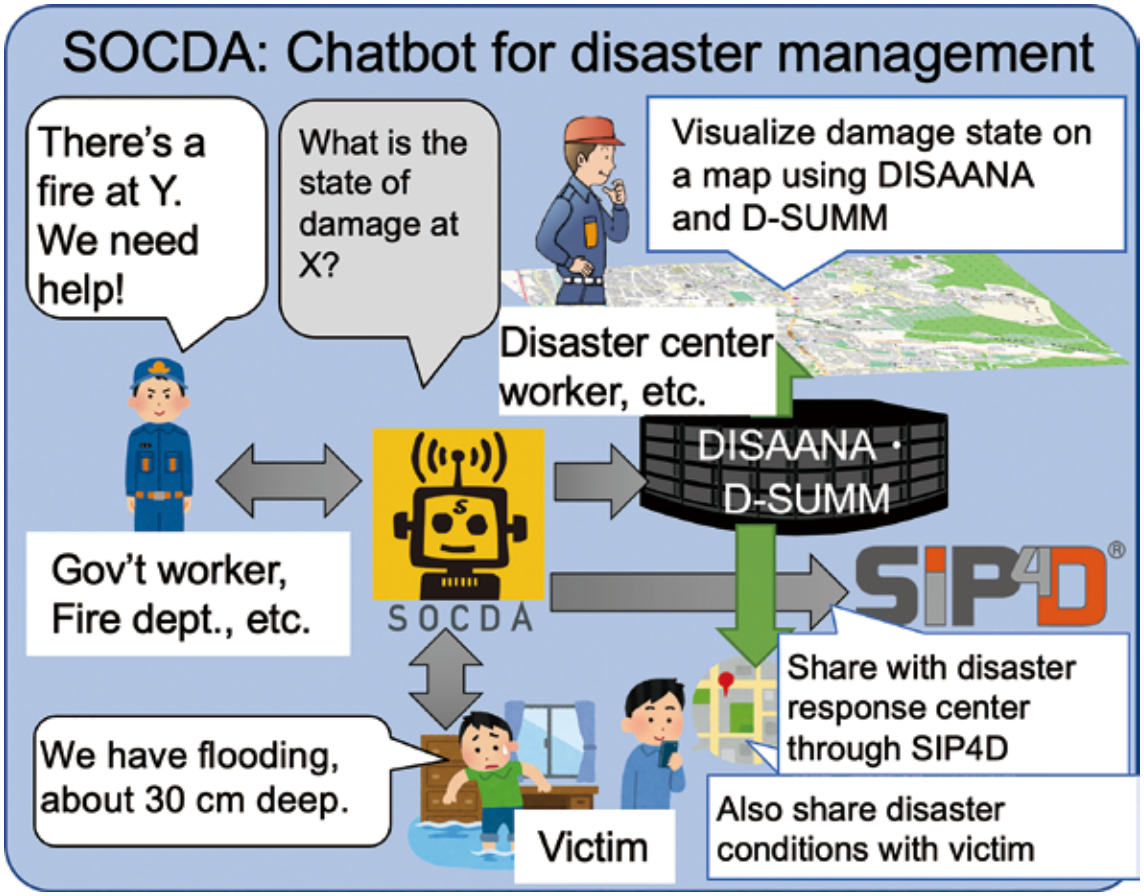
With over 80 million users, LINE is currently the SNS with the most users in Japan, so in terms of coverage, it is promising for implementing a service in society. An overview of SOCDA is given in Figure 1. There are two main functions implemented by SOCDA. One is information gathering, and the other is information distribution. Rather than having individual citizens providing information spontaneously and exhaustively, the desired information can be collected, and processed, and new decisions regarding disaster response can be distributed quickly. NICT has contributed to SCODA R&D with technology to analyze the collected information and visualize it on a map, applying technologies from DISAANA and D-SUMM. In doing so, we have advanced R&D on more user-friendly visualization methods and more accurate methods for analyzing the collected information.

In past R&D on DISAANA and D-SUMM, we have shown that Twitter and other SNS are platforms that treat people as a kind of sensor. However, by implementing bi-directional communication on the SNS, extending the analogy, we can also treat people as actuators. We could also say they are acting as active sensors, rather than passive sensors. As such, we can expect to be able to collect a range of information quickly, even under conditions that we could not previously, such as checking disaster conditions when a disaster has occurred during the night. Reliable positioning information, photographs and video can also be shared now, so it is possible to collect the desired information quickly, and information contributing to evacuation and other activities can be distributed quickly.

When implementing bi-directional communication with this sort of chatbot, it is desirable for the text chat to feel like interacting with a person, but when a large-scale disaster occurs, a real problem is that information needs to be collected from, and distributed to, a huge number of people over an extremely short period of time. As such, we prioritized scalability in the design and implementation of SOCDA, so that we could maintain a minimum level of quality that people can tolerate in the disaster prevention-domain, while handling numbers of interactions in a short time that would be overwhelming if attempted by human personnel.

As a result of active trials with local governments and other organizations since FY2018, most issues are being clarified, including technical but also institutional and other issues. For

Figure 1: Overview of SOCDA, a chatbot for disaster management



example, there is a responsibility issue with a chatbot for disaster management. To enable bi-directional communication, members must become friends with the SOCDA account, but without a clear commitment to taking responsibility in handling shared information, it will be difficult to gain members' cooperation. There is also an issue of how the information provided to SOCDA by residents is handled. In prior tests, information was gathered in a format that anyone could look at, and information was used in a way that the information provider remained anonymous. This helped curb any resistance to providing information, but who provided the information and from where was unknown, so it was difficult to encourage cooperation and information sharing within the community.

On the other hand, relatively soon after R&D began, we began studying use of SOCDA for communication with personnel and collaborating facilities such as the fire department, rather than with general residents. Use by government or fire department staff in this way means it is being used at the front lines of disaster response, and we realized there were hardware and other constraints that we had not anticipated earlier (Smartphones require touch, so they cannot be used hands-free. We also want to use speech recognition to simplify input, but could not always obtain the desired results due to noise from heavy rain and other causes).

We also heard from one government agency, that a large amount of effort was required to confirm the safety of people needing help with evacuation when a typhoon was approaching. They inquired whether SOCDA could be used for that purpose. We conducted two trials of this application. In the first trial, we checked the basic functionality using test data, and in the second trial, we had people needing help become friends on SOCDA and LINE, and enter their safety information under conditions similar to a real environment. This showed the technical potential, but also exposed issues requiring further study, such as how personal information should be handled.

In January, 2020, we also conducted a large information gathering drill using SOCDA on a scale of ten thousand participants in Kobe City. We verified performance in collecting a large volume of information in a short time, reduced the volume and increased the speed when providing results of visualizing the information to many during that same short time. We were able to verify and make improvements for even larger-scale use in the future.

We plan to continue implementing various planned features in SOCDA and to verify them in practical tests.

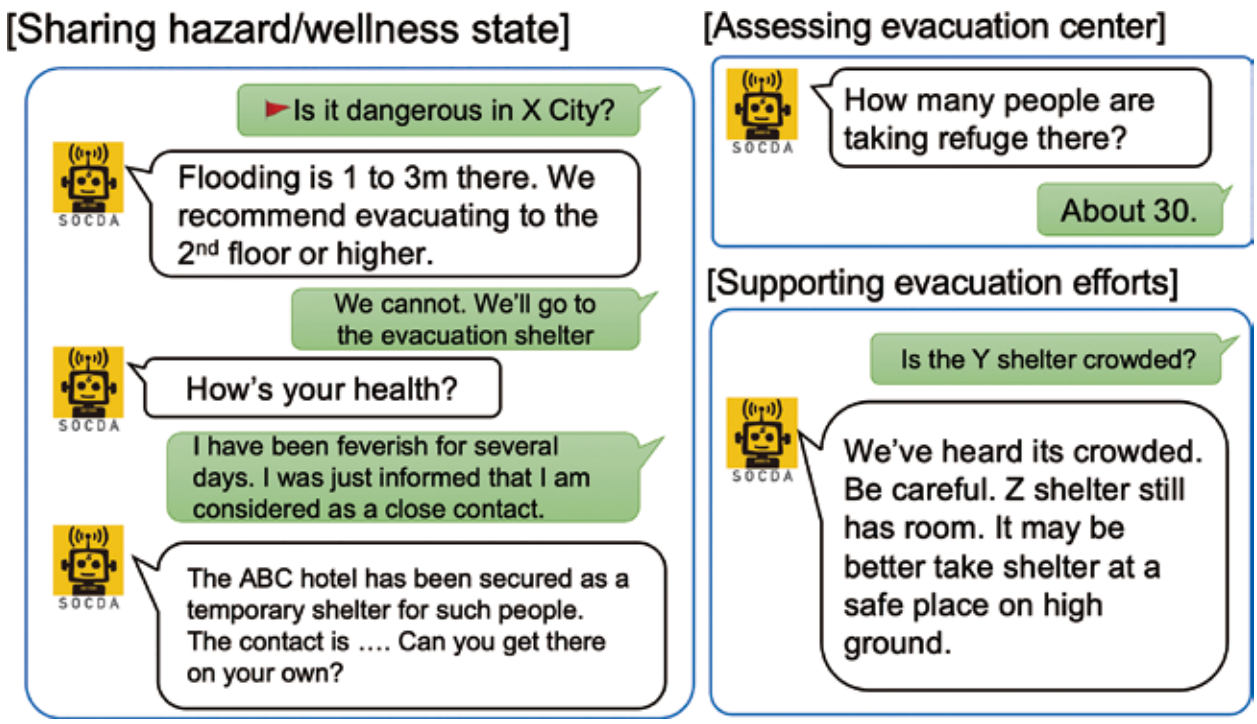
4. Disaster prevention and mitigation using SNS in the Corona Era

From our experience with the spread of the new coronavirus, preventative measures are being taken in all aspects of our lives, including the field of disaster prevention and mitigation. We have experienced large scale storm and flood damage every year for the past several years, so large-scale disasters are sure to occur in the future, and we are studying how to deal with them. There is a wide range of information currently circulating regarding the novel coronavirus, and there may be those who have doubts about an expression like "Corona Era," but here, we use it here to indicate the current state in which we do not have immunity, and live with the possibility that the disease could spread. This applies more broadly than to the current novel coronavirus, and could also apply, for example, to a new influenza virus.

There are two areas of difficulty in dealing with disasters in this Corona Era, particularly related to evacuation efforts. The first is that infected people will evacuate to shelters, producing so-called clusters and spreading the infection. The second is that an increasing number of people are not seeking refuge appropriately for fear of infection and this itself is a threat to their lives. We are working to support disaster response by providing information to help with these issues. Interacting with the chatbot for disaster management can provide support by confirming disaster hazards, checking people's health status, and with decisions whether evacuation is needed or not. Then, if there is suspected infection when checking a person's health before evacuation, SOCDA can automatically provide information regarding suitable facilities that have been prepared by the administration, rather than having a person do it. For people that are considering evacuating, current information regarding evacuation shelters can be provided in a timely manner to encourage appropriate evacuation measures, such as whether they are crowded, or whether appropriate measures to handle infection are being taken. Also, by presenting the option of taking refuge in their own homes based on hazard information such as where flooding is expected to occur, some will be able to avoid the risks of evacuation shelters (enclosed spaces, crowded conditions, close contact), and the risks of traveling to the shelter. An example of a possible interaction with SOCDA for this sort of application is shown in Figure 2.

We call evacuation to protect life, as discussed above, life preserving evacuation, and we have discussed the potential for use of SNS in this phase of evacuation. It is followed by a phase of on-going life at the evacuation location, which we call "ongoing evacuation," and there is also strong demand for SNS in this second phase. The discussion above regarding life preserving evacuation envisioned mainly storm and flood damage, but the situation is somewhat different for earthquakes. Whichever the case, for large scale disasters in the Corona Era, we expect that fully dispersed evacuation will need to be planned. As such, although in the past it was okay to provide the necessary goods and services for ongoing evacuation, such as medical

Figure 2: Example of conversation on SOCDA during a disaster considering measures to prevent infection



help, centrally at designated evacuation shelters, in the Corona Era, these must also be provided in a distributed fashion, or each survivor will not be able to receive the support they need. This applies not only to direct support, but is also important for information, and the SOCDA can be used to gather and provide information comprehensively. This involves both (1) gathering information regarding evacuation locations (e.g. finding non-designated or provisional shelter (hotels, etc.) locations) and whether medical treatment is needed, and (2) providing information such as locations where supplies will be available, and providing information necessary to preserve health in ongoing evacuation (e.g. warnings regarding sleeping in a vehicle, etc.).

Most of these features were conceived when R&D on the chatbot for disaster management began, but there was no particular emphasis placed on using it to check the well-being of survivors. In considering disaster response in the Corona Era, this is a significant point of difference from earlier approaches. While it is clear that there is a need to develop a chatbot that can interactively check people's well-being and provide appropriate information in this way, in some cases this could involve handling sensitive information, so various issues regarding operation and organization will require further study, such as who will have access to such collected information, and how will it be used. We also expect that in practical terms, it will be important to have a mechanism to provide specific guidance to an online medical service at an early stage. Discussions on these and other issues will be conducted through the Council on Artificial Intelligence for Disaster Resilience (https://caidr.jp/), which was launched in June, 2019.

5. Conclusion

In this article, we have introduced initiatives using AI with disaster-related information found on SNS, for disaster prevention and mitigation. We first introduced two systems, DISAANA and D-SUMM, which analyze disaster-related information on Twitter. Then, we showed that information posted spontaneously on Twitter is not adequately comprehensive, and we introduced SOCDA, which is a chatbot for disaster management that resolves the issue by implementing bi-directional communication on the LINE SNS. SOCDA is still under R&D, and we will continue working to contribute to disaster prevention and mitigation, while also incorporating features to prevent the spread of the new coronavirus.

References
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