

Study on Accessibility of Urgent Message Transmission Service in a Disaster

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Abstract. In this paper, the layer model of urgent message transmission service is proposed and the semantic level channels of communication inescapable when considering the accessibility of an urgent message are discussed.

Keywords: accessibility, urgent message, sign language.

1 Introduction

When natural disasters, such as an earthquake or a flood occur, an urgent message transmission service for minimizing damage is indispensable. The urgent messages are needed to transmit the situation, evacuation plans, etc. correctly to residents. They can guide the residents to suitable evacuation sites and contribute to safe movement patterns. To transmit urgent messages to residents we need more than just a communications network. We must have assurances that the messages will be received by the residents and will be understood, even in an emergency. Therefore, the communication channels for urgent message transmission have a layered structure consisting of a media layer with its physical channels for communication, and a semantic layer, which provides logical channels for communication. The channels in the media layer are formed by physical links and so can be influenced by physical disasters, such as the loss of a wireless relay tower. On the other hand, the semantic layer channel is not established until the meaning of the message is correctly understood by the recipient. This is influenced by the recipient's physical and mental condition, knowledge, etc. A foreigner unfamiliar with the official language of a disaster area, for example, will not understand the meaning of an urgent text-based message. In this case, although the physical channel is reliable, the logical channel is unreliable. Previous research on the urgent message transmission service focused on the media layer and ignored the semantic layer. Comprehensive research on accessibility of the urgent message, which must consider the recipient's physical and mental condition, is impossible to find.

This paper proposes the layered model of urgent message transmission service, and discusses the semantic layer communication essential to assuring the accessibility of urgent messages. Urgent message transmission service to deaf people is taken to be an example of semantic layer communication, and the transfer characteristic has been

investigated experimentally. The use of visual displays is introduced as an example of a semantic layer channel. An experiment showed that differences in the display format of a message influence the transfer characteristic of the semantic layer channel.

2 Layer Model of Urgent Message Transmission

The layer model of urgent message transmission is shown in Figure 1. From the left, the sender transfers disaster information to the receivers. When a disaster occurs, one of more local autonomous organizations collect damage information and transmits it to disaster victims through various physical channels, i.e. the media layer. The channel consists of terminal units and a communication line. The person in charge (sender of a report) of a local autonomous organization transmits, for example, an evacuation order based on the collected disaster condition report to the victims. The order, input via the organization's terminal, is relayed to a server near the disaster area through an existing communications network (cable or radio), and then transmitted to the victim's terminal. The receiving terminal displays the transmitted signal as text, sounds, images, or various combinations thereof, to the victim. Materializing this media layer channel is the first step. In an actual disaster, since various factors (for example, communication line cut, congestion, and failure of server or terminal) can impede the establishment of media layer channels, it is necessary to have path redundancy. Note that here we ignore communication channels that permit message distortion, for example, oral messages and handwritten memos. Sociological factors, such as the dissemination of false rumors, need to be considered for person-to-person communication. The 2nd layer in Figure 1 is the semantic layer. In this layer, the intention of the message sender's should be correctly understood by the receiver (a human). There are some grades in an evacuation order, for example, recommendation of preparation of evacuation, a direction of an evacuation beginning, a direction of immediate evacuation, etc. However, correspondence with the grade of an evacuation order and the words representing the grade is not fully understood by residents in general. This is because a word without the familiarity for residents is contained in an evacuation message. The transmission pass of the semantic layer channel is not established in such case. Also when the linguistic backgrounds of the message sender and receiver differ, the semantic layer channel is not always formed appropriately. When transmitting a Japanese message to the deaf people using sign language in everyday life, the suitable semantic layer channel may not be established. Because, Japanese is not a native language for deaf people. Examination of the semantic layer channel in consideration of deaf people's linguistic skill is needed.

3 Universal Design of Urgent Messages

In order to illuminate the semantic layer channel, this chapter discusses the universal design underlying urgent message transmission for deaf people. For most deaf people the first language is signing, Japanese is the 2nd language. Since our mental workload is high in an emergency, an urgent message must be easy to be understood. In public

spaces, the method created for deaf people displays sign language and Japanese text simultaneously. This is far from optimal since many deaf people note that message understanding in public space is difficult. Since sign language is premised on the conversationalists being together, its effectiveness in one-way information presentation (the flow of information is one way from sender to receiver) is low. Furthermore, since Japanese is a second language for deaf people, it is difficult to understand a message certainly and quickly in emergency. Moreover, since the two types of visual media are competing for the receiver's attention, overall information passing is poor. For this reason, when deaf people read an urgent message, the strategy which compares the both sides of sign language and a Japanese text is performed. Therefore, the presentation format which helps comparison of sign language and Japanese easier is required of the universal design of information to deaf people. We proposed listed sign language as the optimal presentation method for passing urgent messages to deaf people. Listed sign language is a presentation format that displays itemized Japanese text and sign language fragments side by side. A comparison of against sentence message presentation (the conventional method) with listed sign language showed that the latter was ranked significantly more successful by deaf people. That is, the success of the semantic layer channel strongly depends on the information presentation format.

4 Urgent Message Reading Experiment by Listed Sign Language

Figure 2 shows an example of a message presented in the listed sign language format. The written expressions are displayed in table form on the left side of the screen. The corresponding sign language movie on the right side. Differences in sign language skill and the variation in Japanese sentence comprehension could be overcome by the listed sign language technique. An experiment was conducted using 25 subjects ranging in age from 20 to 60 (average age of 34, $SD=11.7$). Based on gaze measurements, the subjects' reading strategies encompassed three types.

- JSL dominant: JSL movie received the most attention.
- JT dominant: The Japanese text received the most attention.
- Neutral: No one form predominated.

The recorded data is shown in figure. 3. It was found that subjects compared JSL with JT. This comparison improved the comprehension of expressions that were hard to understand when expressed in only one form. For example, it is more intelligible to read a text, although a numerical value and a proper noun are expressed by the finger character in sign language. In interviews after the experiment, the subjects noted that while listed sign language was initially found to be incongruous, urgent messages by listed sign language format were easy to understand. The subjects' impressions of the three methods were collected at the end of the experiment using a questionnaire with the following five items.

- (1) Accuracy: I think that the message was transmitted correctly.
- (2) Quickness: I think that the message was transmitted quickly.
- (3) Easy understanding: I think that it was easy to understand the message.

- (4) Conformity with emergency: I think that this displaying method is suitable for urgent messages like this time.
- (5) Sense of security: I think that this display method provides a sense of security.

Figure 4 shows the results of an analysis of the responses. Long sentence sign language results (black bars) are topped by those of listed sign language (white bars). Listed sign language messages were well accepted by deaf people.

5 Discussion

In list sign language, since sign language is fragmented according to itemized statement Japanese, there is sense of incongruity from deaf people. Interview to deaf people showed that although the long sentence was good at the time of usual, list sign language was good in an emergency. In an emergency, a message needs to be understood certainly quickly. Therefore, a message needs to be read, comparing sign language with Japanese. That is, in the universal design of an urgent message, it needs to be taken into consideration that comparison of sign language and Japanese certainly occurs. Thus, in urgent message presentation service, it is important to be taken into consideration to establishment of a semantic layer transmission channel in addition to a media layer.

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