Paper for a special issue of AI & Society on:
"Exploring Civic Intelligence: Descriptions & Prescriptions".

TITLE:

Multilingual Disaster Information System: Information Delivery Using Graphic Text for Mobile Phones

AUTHORS:

Satoshi Hasegawa

Associate professor, School of Information Culture, Nagoya Bunri University, Japan
Address: 365, Maeda, Inazawa, Aichi, 492-8520, Japan
E-mail: hasegawa@nagoya-bunri.ac.jp **Telephone**: +81-0587-23-2400 **Fax**: +81-0587-21-2844

Kumi Sato

Student, Graduate School of International Development, Nagoya University, Japan
Address: Furo-cho, Chikusa-ku, Nagoya, 464-8601, Japan

Shohei Matsunuma

Student, Graduate School of Industry, Nagoya Institute of Technology, Japan
Address: Gokiso-cho, Shouwa-ku, Nagoya, 466-8555, Japan

Masaru Miyao

Professor, Information Technology Center, Nagoya University, Japan
Address: Furo-cho, Chikusa-ku, Nagoya, 464-8601, Japan
E-mail: mmiyao@med.nagoya-u.ac.jp

Kohei Okamoto

Professor, Graduate School of Environmental Studies, Nagoya University, Japan
Address: Furo-cho, Chikusa-ku, Nagoya, 464-8601, Japan
E-mail: h44540a@cc.nagoya-u.ac.jp

Abstract

A multilingual disaster information system (MLDI) has been developed to overcome the language barrier during times of natural disaster. MLDI is a web-based system that includes templates in nine languages so that translated texts can be made available immediately. Mobile phone e-mail with graphic text is a useful tool for delivering multilingual disaster information. The visibility of graphic text on mobile phones was measured and found to be equivalent to the built-in font. However, visibility deteriorates as the character size becomes smaller, especially, on displays with poor resolution. This article also discusses the necessity of multilingual information and measures for a safe and barrier-free society.

Key words: Living support in disaster; Mobile phone; Template translation; Disaster provision; Visibility of characters

1 Introduction

Disaster information or other important information must be made available to all people in a country, including foreign residents and travellers who cannot understand the native language of the country. The Great Hanshin-Awaji Earthquake occurred in Japan on January 17, 1995, and killed 6433 persons including 910 people who died afterwards as a result of the earthquake (Great Hanshin-Awaji Earthquake Memorial Research Institute 2004). In the period following the earthquake, many foreigners who could not understand the Japanese language experienced great difficulty in finding refuge or to obtaining goods for survival in the disaster area.

More than 1,850,000 foreign residents from more than 180 countries are in Japan (as of 2003). This number is ~1.5% of the total population of Japan and is increasing year by year. It is necessary to provide disaster prevention and refuge information in multiple languages. However, it is not easy to rapidly and accurately translate various information into a number of languages in times of emergency. In this paper, we introduce a multilingual disaster information system (MLDI) that translates a range of information on natural disasters, including earthquakes, volcanic activity, and floods from heavy rain, quickly and accurately into 8 languages. Our MLDI is a web-based system in which translated

multilingual sentences are available from a web site on the Internet, after the user fills in the blanks in the Japanese template sentences with the appropriate parameters of location, days or times. Although MLDI is now a prototype system, we have recommended the use of this system in Niigata prefecture, Japan, where the Niigata Chuetsu Earthquake occurred on Oct. 23, 2004 and 40 people have died (as of Nov. 22, 2004) (Niigata Prefecture 2004). Natural disasters such as earthquakes, volcanic eruptions, hurricanes, cyclones, typhoons, storms, tidal waves, and floods from heavy rain may happen at some time in all areas of the world. Disaster information in multiple languages is useful in such situation.

Disaster information should be also accessible from all places in and near the area of calamity. Mobile phones (MPs) are one of the most useful tools for the timely reception of information. We propose to send multilingual disaster information generated by the MLDI system to MPs with the use of graphic text e-mail. Although ordinary types of MPs support only alphanumeric characters and the characters of the native languages in a country, multilingual characters can be displayed by using graphic text. Graphic image data representing characters, such as in the JPEG format, can be easily displayed by commonly used MPs.

However, the liquid crystal displays (LCDs) on MPs are smaller than the displays of other devices such as personal computers, and JPEG is not necessarily suitable for representing such binary image data as characters. We studied the visibility of graphic characters on the LCDs in MPs through experiments in which subjects read graphic text on MPs. Experiments were conducted with English, Japanese, Chinese and Korean, respectively as described later in this paper.

2 Template Translation for Multilingual Disaster Information

Although automatic translation systems have been studied and developed using various methods, complete translation of natural languages into other languages is difficult. In the case of disaster information, correct translation is essential. Fortunately, most disaster-related information can be expressed in short sentences with fixed form. Template translation is one possible means to produce multilingual information quickly and accurately. Other requirements for a disaster information system are mentioned below.

2.1 Requirements

Disaster information needs to be sent to all disaster victims including foreign residents, and to be available for travellers in a language they understand. Such information should immediately reach victims no matter where they are. Correct and timely information is necessary to make damages as small as possible. Public announcements must be understood by all persons. Reports from residents in disaster spots about traffic conditions or other local information for daily life is also required so that victims can get survival goods or move to appropriate shelter. Moreover, the true meaning of provided information is in some cases difficult to decipher for foreigners who have insufficient knowledge about the culture. For example, in Japan earthquake intensity is expressed in the Japanese scale of seven (from 1 to 7). This seismic intensity is used in public announcements in Japan. However, people who are unfamiliar with this scale cannot understand the intensity without special explanation. Word for word translation can not generate sufficient information for foreigners. A template translation method would therefore seem to be useful to provide appropriate information for foreigners who need additional explanations or special information.

2.2 Possible Methods

One possible method to produce multilingual texts is to use numeric or coded data as an information source. Data issued by public offices following a disaster or official warnings can be categorized and provided with fixed explanations in this method. One part of a telegraphic message issued by the Japan Meteorological Agency (JMA) is shown in Fig. 1 (a). This type of telegraphic code would be used after being decoded into natural languages such as English (as shown in Fig. 1 (b)) or Japanese, according to the decoding protocol previously published by JMA. In such cases, once the necessary templates are prepared in multiple languages, receivers can easily and immediately translate the code into multilingual sentences (Fig. 1). This method is effective for information that will be announced according to a previously agreed protocol (JMA 2004, JWA 2004, SBS 2004b, SBS 2004c).

Another method is to generate multilingual messages from a message expressed in one language. Proper nouns representing locations or names of goods and numeric data for dates, times, degree and number of equipment, etc. should

first be extracted from the text of disaster information expressed in the original language. These extracted terms should then be put into multilingual templates appropriately. This approach is promising and should be studied for practical use in the near future.

Another approach is to use multilingual templates prepared previously for both original and translated messages. Templates should be prepared in sufficient number and with sufficient contents in several languages including the original language. Once the user fills in the blanks in the template of his/her native language, multilingual information will be generated instantaneously. The Multilingual Disaster Information System (MLDI) described below was developed under this concept and is now in practical application as a prototype system to be refined and expanded.

2.3 Multilingual Disaster Information System (MLDI)

MLDI has been developed by the Multilingual Disaster Information System Consortium (Miyao M and Okamoto K 2004, Sato et al. 2004a, Sato et al. 2004b). The MLDI shown in Fig. 2 is a web-based system. This system has more than 1,100 different template sentences classified into 40 categories in 7 groups, as shown in Fig. 2. Once a user fills in blanks in the Japanese template in the edit mode and pushes the translation button, translated sentences appear in 5 languages, Japanese, English, Korean, Chinese and Portuguese, in this prototype version. We have already expanded this system to include 9 languages by adding Taiwanese, Spanish, Tagalog and Indonesian. MLDI now includes more than 9,900 templates.

2.3.1 Web-based System

MLDI is a web-based system with a system architecture that consists of two kinds of servers for the purpose of distributing the web server load at times of calamity. One is the “translation server” and the other is the “template server”. The template server has a database including the multilingual disaster prevention information template that is referenced when requested from the translation server. These two types of servers are connected with Simple Object Access Protocol (SOAP) and the translation server translates the source template into multiple languages using the data-base on the template server. MLDI is designed to distribute processing

performance so that web service can be maintained during the heavy load at the time of a calamity.

2.3.2 Category of Contents

Templates in the current version of MLDI are classified into the 7 groups of (1) before the occurrence of an earthquake, (2) after earthquake occurrence, (3) damage and relief, (4) life information, (5) traffic and lifelines, (6) safety and consultation, and (7) full information, as shown in the upper part of Fig. 2 in Japanese. Each of these 7 groups includes several categories shown as the buttons in Fig. 2. The total number of these categories is 40. The names of the categories are as follows:

Five categories in group (1): a cautions stage, observation stage, watching stage, announcements from the Meteorological Agency, and announcements from local government;

Seven categories in group (2): information on earthquakes, tsunami or tidal waves, aftershocks, refuge advice, evacuation areas, risk avoidance, and calling attention;

Seven categories in group (3): damages, fire, fire extinguishing and rescue, medical treatment, goods distribution, water supply, and volunteers;

Seven categories in group (4): toilet, bathing, refuse disposal, financial institutions, sale, schools, and weather bulletin;

Seven categories in group (5): telephone and Internet, electricity supply, gas, water service, road, railroad and bus, and aviation and shipping;

Five categories in group (6); safety information, consultation center, residence, suffering amelioration, and entrance into Japan;

Two additional categories in group (7); full information in Japanese, and information for foreigners.

2.3.3 How to use MLDI

The categories of the templates mentioned above can be selected by pushing a button, as shown in Fig. 2. The contents of the templates shown in Fig. 2 are limited to earthquake and living information for victims.. A user can easily choose the appropriate template from the list displayed after the category is selected. The language used to edit the template is also limited to only Japanese in this

prototype version. The blanks in the Japanese text can be filled with the numbers, Roman letters or Japanese characters representing the name of places, dates, times, telephone numbers, or other information. In this version, the edited Japanese templates are translated into complete texts in four languages, English, Korean, Chinese and Portuguese, just by pushing the “Translate” button. The translated templates are as shown in Fig. 3.

Translated texts can be downloaded as texts coded in Unicode (UTF-8) so that the user can combine them or lay them out suitably using MS-Word or other editors supporting Unicode. This translated matter can be printed and distributed or put up as notices. The translations can also be sent by e-mail. Sending e-mails to mobile phones is a particularly useful method to deliver disaster information, as mentioned below.

3. Information Delivery

Although there are many possible methods to deliver multilingual disaster information, mobile phone (MP) e-mail is superior to methods such as distributing printed matter or e-mail sent via personal computers, in terms of its quickness and independence of the location or supply of electric power (Fig. 4).

However, ordinary MP models used in Japan do not support multilingual characters. They can only display alphanumeric characters, Japanese and several symbols. On the other hand, almost all of these MPs can display digital images in JPEG format. This function was originally used to display natural photo images such as scenery or portraits taken by the built-in cameras. Graphic text is useful to send multilingual short phrases to MPs that do not support the languages in question (Hasegawa et al. 2004). Although the data size for graphic images attached to a single e-mail on MPs is limited, a small amount of image data is suitable for display on the small LCDs of the MPs, and is also suitable for the short phrases of multilingual disaster information generated by MLDI as shown in Fig. 3.

3.1 Mobile Phones and the Visibility of Graphic Text

Although graphical image data attached to e-mail is usually used for sending digital photographs, graphical characters, or image data expressing characters, are also useful in sending multilingual e-mail of unsupported fonts to MPs. An image

data format supported in the e-mail system of many types of MPs was developed by the Joint Photographic Experts Group (JPEG) for photographic images. However, the JPEG format is not necessarily suitable to representing characters. Moreover there have been few studies on visibility of characters on the LCDs in the MPs (Omori et al. 2002), although visible character size have already standardized in the case of VDT works on the personal computers (Miyao et al. 1989, ISO 1992, JIS 2003). Visibility of characters on The visibility of graphical characters in mobile phones should be studied, including the influence of the quality of the LCD in the MPs. We have measured visual performance to verify the visibility of graphic text on the LCDs in MPs.

3.1.1 Method of the Experiments

Subjects sat on a chair and read aloud sentences displayed on an LCD in an MP, and their reading performance was measured. Two experiments with different purposes were held as follows.

Experiment 1: The purpose was to compare the visibility of graphic text with that of text shown in the font equipped in the MP. The subjects were 28 Japanese males and females aged 20-41 years (24.8 ± 6.9 years). An MP of type A, the specifications of which are shown in Table 1, was utilized in this experiment. Four samples of Japanese text were used: font (character size: small), graphic text (small), font (very small), and graphic text (very small). Examples of graphic texts in each character size are shown in Fig. 5 (c).

Experiment 2: The following four examinations were conducted in order to evaluate the influence of character size and type of MPs on the visibility of graphic text on LCDs in MPs. Each subject was a native speaker of the language in which he or she was tested. Subjects' languages were as follows: (a) English: 23 persons, age: 31.0±6.0, (b) Korean: 19 persons, age: 31.8±5.3, (c) Chinese: 10 persons, age: 27.6±4.1 and (d) Japanese: 24 persons, age: 23.5±2.2. MPs of both Type A and B were used for experiment (a) and (b). Type C and D were used for experiments (c) and (d). The specifications of these MPs are shown in Table 1. Type A has higher luminosity and resolution than B, and type C has higher specifications than D.

Samples of graphic text in three different character sizes but same number of characters were prepared as shown in Fig. 5 (a) and (b). All image data were

saved in amounts lower than 6KB (for MP type B, C, D) or 30KB (type A), so that they could be sent by MP e-mail. A sufficient number of samples with different contents selected from the templates in MLDI were prepared. Samples were displayed in rotating order so that no subject read the same contents. Reading time and visual distance between subjects' eyes and LCD was measured. Subjective evaluations on a 5-point scale (5: very easy to read -1: very difficult to read) were also recorded every after each reading task.

3.1.2 Results

Results of experiment 1 are shown in Fig. 6. The results of a two-way ANOVA with character size (small or very small) and type of text data (font or graphic text) as factors showed that only character size was significant as a main effect in subjective evaluation ($p<0.001$) and visual distance ($p<0.05$). Neither the type of data nor the interaction had a significant effect. The p-values shown in Fig. 6 are the results of a t-test conducted with mean values, with consideration of pairs in data for each subject. In this test, subjective evaluation, reading speed and visual distance were all significantly lower with very small size than small size text, although the type of text data had no significant effect.

Results of experiment 2 are shown in Fig. 7. Results for English, Korean, Chinese and Japanese are shown in Fig. 7 (a)-(d), respectively. Results of a two-way ANOVA showed significant effects in both the main factors of character size and type of MP in subjective evaluations. Reading speed and visual distance decreased, although the differences were not significant, as the character size became smaller. This was as the same as the result of experiment 1 shown in Fig. 6. With all languages, there were significant differences in the subjective evaluation with the size of characters, especially in the lower-specification type of MP.

These two experiments demonstrated the possibility of applying graphical character e-mail in MPs to the multilingual information delivery in the English, Korean, Chinese and Japanese languages. However, it must be noted that visibility was insured as the character size became smaller, especially when the low resolution type MP was used.

3.2 Discussion on Information Delivery

We demonstrated that graphical text was as visible as text in the built-in font on LCDs in MPs, as long as the resolution of the LCD was not too low. Short messages like the disaster information generated by MLDI can be sent by this method. However, the disaster information needed in an emergency varies. Urgent messages such as warnings for tsunami or tidal waves must reach people within a few minutes after an earthquake in some cases. On the other hand, living information such as the places of the shelters or the traffic conditions can be made available any time. Disaster information should be delivered to people who need it, at an appropriate time in an appropriate format, and in an appropriate language. We hope some media will be developed as a strong tool to deliver disaster information quickly and reliably in a calamity situation. Diversified media should be used to deal with various situations in times of calamity.

4. Conclusion

A template translation technique and graphical character e-mail on mobile phones were described in this paper. These techniques are essential to our multilingual disaster information system. Multilingual information will be helpful in creating a barrier-free society, including for many foreign residents. Emergency information in particular should be accessible to people of all nationalities. We assessed the performance of the translation system and the visibility of multilingual graphical characters, and found that they are sufficiently useable. However, the results of this study also include suggestions to improve this system and make it more practical. Problems that need to be solved are mentioned below.

5. Further Considerations

Our purpose is to realize a barrier-free society in the near future through global communication using a multilingual information system. Disaster information in particular should be available to all people including foreign residents, travellers, infants, elderly, and handicapped. Appropriate instructions are necessary for foreigners who do not have experience or knowledge about how to cope with disasters or the possibility of disasters in the country they are living in. People who are at a disadvantage in obtaining information, including elderly or

handicapped, should be considered to be at a disadvantage in times of calamity. Further measures should be proposed for such situations in order to realize a completely barrier-free and impartial society, at least during natural disasters.

Acknowledgement

The Multilingual Disaster Information System (MLDI) was developed by the members of the Multilingual Disaster Information System Consortium. We thank Mr. Tetsushi Okuyama at Shimadzu Business Systems Corporation in Japan (SBS 2004a) for his useful instructions about weather information and its delivery to mobile phones.

References

Great Hanshin-Awaji Earthquake Memorial Research Institute (2004) Great Hanshin-Awaji Earthquake Research Paper, http://www.hanshin-awaji.or.jp/kyoukun/eng/

Hasegawa S, Irie Y, Omori M, Matsunuma S and Miyao M (2004) Visibility of graphical character e-mail in multiple languages on mobile phones, ESK and JES Joint Symposium 2004, 5-Jun-04, The Japanese Journal of Ergonomics, 40 Supplement: 50-53

ISO (1992) ISO 9142-3, Ergonomic requirements for office work with visual display terminals (VDTs)

JMA (2004) Japan Meteorological Agency, http://www.jma.go.jp/JMA_HP/jma/indexe.html

JWA (2004) Japan Weather Association, http://www.jwa.or.jp/english/

JIS (2003) JIS S 0032, Guidelines for the elderly and people with disabilities—Visual signs and displays—Estimation of minimum legible size for Japanese single character

Miyao M, Hacisalihzade SS, Allen JS and Stark LW (1989) Effect of VDT resolution on visual fatigue and readability: an eye movement approach, Ergonomics, 32(6):603-614

Miyao M and Okamoto K (Representatives) (2004) Multilingual Disaster Information System Consortium, http://tagengo.seis.nagoya-u.ac.jp/

Niigata Prefecture (2004) Earthquake information, http://www.pref.niigata.jp/sougouseisaku/kokusai/english/

Omori M, Watanabe T, Takai J, Takada H and Miyao M (2002) Visibility and characteristics of the mobile phones for elderly people, Behavior & Information Technology, 21(5): 313-316

Sato K, Okamoto K and Miyao M (2004a) Multilingual and ubiquitous information system for disasters, ESK and JES Joint Symposium 2004, 5-Jun-04, The Japanese Journal of Ergonomics, 40 Supplement: 88-91

Sato K, Okamoto K and Miyao M (2004b) Template system for translating disaster information into eight different languages, The 14th International Conference on Artificial Reality and Telexistence, ICAT 2004, Nov. 30-Dec.2, Korea

SBS (2004a) Shimadzu Business System Corporation, http://www.shimadzu.co.jp/sbs/

SBS (2004b) J-Tenkys -Weather information for mobile phones (in Japanese)-, http://www.shimadzu.co.jp/sbs/jten/

SBS (2004c) Kansai Weather –a local area weather information service-, http://tenki.shimadzu.co.jp/