

Picture-Mail System - Means of Signed Language Communication over Internet -

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Abstract

This paper addresses the use of an e-mail service over the Internet as a means of signed language communication. We call the system a picture-mail system. The system can transmit messages by signed language in certain presentation forms. This system, therefore, provides a means for signed language communication in off-line manner over the Internet. Deaf people can communicate through the Internet with others not in written text but the medium of signed language. Certain structures and features for typical picture-mail systems are shown, and technological and human issues for these systems are discussed based on preliminary experiments with deaf people.

Key words: Internet; E-mail; Picture-mail; Signed language; Deaf people.

1. Introduction

Information and Communication Technologies (ICTs) have been developing very rapidly in recent years, and have provided various information and communication services. The Internet has played an important role as an infrastructure in our society. Many people use e-mail as a communication means that is different from ordinary telecommunication services. An e-mail service usually requires message in a text form, or written language. Deaf people who use signed language in everyday life, therefore, have certain restrictions on the communication by e-mail due to the difference of two language media.

We have proposed another means of communication called a picture-mail system to reduce the language barrier in an e-mail service. Picture-mail system enables a user to transmit a signing file as the attachment to e-mail (Kamata, Abe, Abe, Fukuda, & Yamamoto, 2000). This system, then, provides a means of signed language communication in an off-line manner similar as a usual e-mail. The picture-mail system proposed (Kamata, Abe, Abe, Fukuda, & Yamamoto, 2000; Fukuda, Abe, Abe, Kamata, & Yamamoto, 2001) has certain variations in both structure and function. We first focus on certain structural factors: (1) Representative medium of signing, or sign words. This includes time-continuous and time-discrete representations. Some examples are; Real signing motion pictures, and computer generated signing animations for time-continuous representation. Photographs and illustrations are time-discrete representations for sign words. (2) Message form to be transmitted. This includes full content transmission scheme with certain motion picture coding method, and parameter transmission scheme based on an analysis-and-synthesis approach. (3) Transmission form with/without a relay service. The relay service widens

the function of the picture-mail system. (4) The language medium of a user: signed and spoken languages. When a user wants to use the system with spoken language, we need certain systems for generating signed language sentences. The combination of these factors specifies the structure and function for a picture-mail system. We introduce certain kinds of systems, and investigate their technological and human issues for these systems.

2. Structures and functions for picture-mail systems

We introduce certain picture-mail systems that have different structures and functions in service. There are four main factors that specify the structure of a picture-mail system: representative media for signing; message forms; transmission modes; and user's language.

2.1 Structural factors

We must consider two kinds of languages, spoken and signed languages, so that deaf and hearing people can communicate with each other through the system. We consider four main factors as shown in Figure 1 for specifying a picture-mail system.

(1) Language medium.

There are two languages to be considered in communication over the Internet: (i) Japanese that has written and speech modality; (ii) Japanese Sign Language (JSL) that is gestural/visual language used by deaf people in Japan.

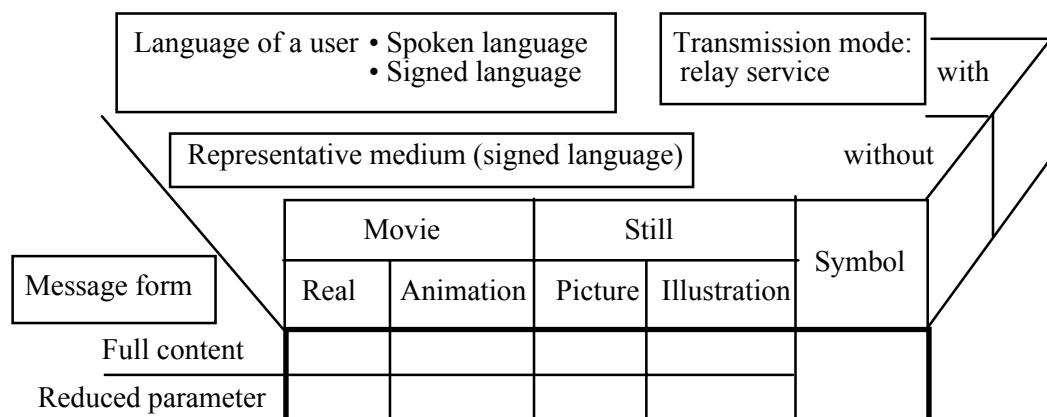


Figure 1. Structural factors for a picture-mail system.

(2) Representative medium.

There are three main categories of media for signing representation, or sign words. (i) Motion picture representation. Signing motion is represented by time-continuous medium like motion pictures, or movies. This includes another dimension for the representative medium; a medium that represents real signing, and that represents simulated or artificial one. (ii) Still picture representation. Time-discrete medium is widely used for books and dictionaries because of ease of manipulation. This includes pictures and illustrations for sign words. (iii) Symbol based representation including gloss representation: An Japanese word or words used to represent a particular JSL sign.

(3) Message form.

There are two forms in transmitting representative media. (i) Full content form. Representative medium is transmitted as it is even if certain data-compression and coding schema are applied. (ii) Reduced parameter form. Representative medium is first analysed and extracted a certain set

of parameters that has sufficient information to regenerate the original one. Only the set of parameters is transmitted to the receiving end, and original message is synthesised by a certain method at the receiving end.

(4) Transmission mode.

A relay service is very useful in certain situations such that the party is not able to understand the message transmitted due to the barrier in language or in medium. There are two kinds of relay services: (i) One is that an interpreter at a relay center translates received message into another language (target language). (ii) The other one is conversion of message within the same language such that of rephrasing sentences (messages). There are two types of message transmission: (i) One is that message processed is sent back to a user. (ii) The other one is the message is sent to another person (receiver) whom the user wants to send the message. Note that the relay service works only in an off-line manner in our study, because a picture-mail system uses a usual e-mail system.

In the following sections we show two typical picture-mail systems that are specified by those factors, and discuss their structures and functions.

2.2 Picture-Mail System (Movie)

Figure 2 shows a typical structure that transmits signing pictures with full content message form. A sender generates signing pictures and transforms them into a movie file with the use of a certain data compression scheme, or a picture coding method. The movie file generated is transmitted to a receiving end as the attachment of an e-mail. A receiver, by using a decoding scheme, generates original signing pictures.

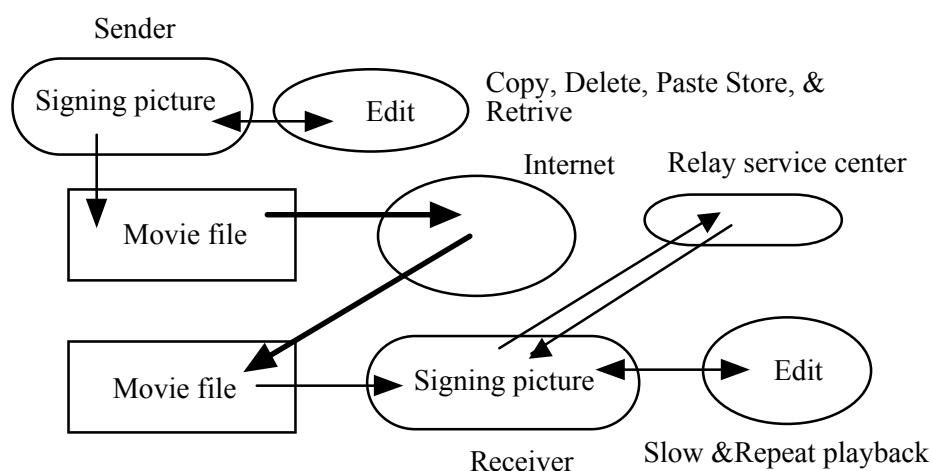


Figure 2. Picture-Mail System(Movie-Full content type).

This system has some variations in structure. When a user generates signing pictures: (i) he/she can utilise Sign Word Processor (SWP) that generates signing motion pictures by pasting prerecorded and stored signing motion pictures for sign words (Kamata, Matsumoto, & Yamagami, 1994); (ii) he/she can use a computer animation system. These two variations provide certain degree of anonymity for a sender, because a user of the system does not need to appear on the signing pictures. In addition to this feature, a user of these systems may not be required good signing skill, because these systems do not require a real signing.

This system have another function, as shown in Figure 2, at the receiving end; slow and repeated playback function for received signing motion pictures. As we will discuss later, the receiving

movie has poor quality of picture mainly due to the low bit rate of a usual Internet channel. The functions above will provide good compensation means for poor picture quality and enhances the intelligibility of signed language messages.

As shown in Figure 2, a receiver can use a relay service to interpret/translate the received message. When a receiver can not understand the signing motion pictures, he/she can ask relay service to get text message. Deaf people can also use the service to confirm the received message in signed language. Note that a sender can use relay service as well as a receiver to get some assistance to generate a signed language message.

2.3 Picture-Mail System(Illust.)

Another interesting picture-mail system is that utilises representative medium suited to reduced parameter message form. Figure 3 shows a typical structure for the system. In this system a user generates a sequence of glosses for sign words; a gloss sequence corresponds to a signed language sentence. Another type of SWP (Kamata, Matsumoto, & Yamagami, 1994; Abe, Kamata, Yamamoto, & Okamoto, 2001) is used to generate a sequence of illustrations, or photographs for sign words. The parameter file consists of glosses, or other kinds of symbols corresponding to glosses. The parameter file received is used to regenerate (synthesise) an original message, a sequence of either illustrations or pictures. We can use, at the receiving end, another medium for signed sentences that is different from that at the sending end, because a synthesis/conversion (parameter-to-sign medium) table enables us to generate sentences with different medium. We will discuss later these features of the system.

In Figure 3, we show a relay service center for translation of the received message. The function of the center is similar to that shown in Figure 2.

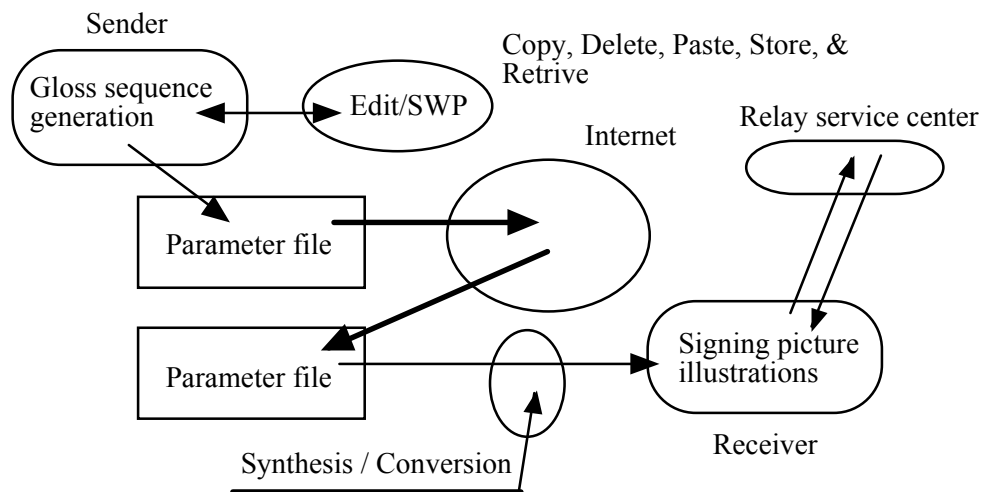


Figure 3. Picture-Mail System(Illustration-Parameter type).

3. Technological and Human Issues for Picture-Mail Systems

We will discuss certain picture-mail systems that are attractive to users. We focus on both technological and human issues of these systems. We also discuss the function of an interpreting service in an off-line manner (translation and rephrasing service).

3.1 Required Systems for Picture-mail Systems

In this section, we show certain systems necessary to make picture-mail systems useful and beneficial to everyone.

(1) FEP (Front-End Processor) for sign.

A user needs FEP to choose an intending sign when he/she generates a sequence of sign words without using Japanese glosses. One approach is that described in Igi, Watanabe, Lu, & Mano (2000). Sign-FEP is essential to the input system for generating signed language messages.

(2) Sign-Animation System.

Computer animation technologies are very attractive in building a sign animation system. An input system will be divided into two categories: Parameter based input system, where a user specifies values for a set of parameters to generate signing animations (Sakiyama, Oohira, Sagawa, Ooki, & Ikeda, 1996; Igi, Watanabe, Lu, & Mano, 2000). Real-motion based input system, where a user is required to simulate signing with the use of certain sensors (data gloves or suit) to extract information about signing done by a user (Kuroda, Sato, & Chihara, 1996). This animation system will suit well to reduced message form (Kamei, & Nagashima, 1999).

(3) Sign-Vocoder.

Another interesting system is very similar in form to a well-known vocoder (voice-coder) for speech transmission. When we want to transmit real signing motion pictures (movies) by a reduced parameter message form, we need to extract certain set of parameters that has information enough to regenerate the signing pictures. Although this is interesting in both technology and linguistic points of view, it may be rather difficult to build the system that works in a real signing situation. When we use certain sensor system as an input tool, we can extract necessary set of parameters easily (Kuroda, Sato, & Chihara, 1996).

3.2 Picture Quality and Intelligibility

In our previous investigation on signed language conversation through ISDN videophones (Kamata, Yamashita, & Hiramata, 1997), we have shown that picture quality specifically temporal resolution is crucial to the signed language perception. We have done similar experiments on the perception of digitized signing movies based on a certain picture coding method (Fukuda, Abe, Abe, Kamata, & Yamamoto, 2001). Where we have used a modified version of APC (Advanced Picture Coding) that has a function for controlling transmission rate. In this study we have used certain coding method and compared with each other from the viewpoint of intelligibility of signing sentences and fatigue for reception. The experimental results have shown similar tendency as that for signed language conversation by ISDN videophones. The situation of picture-mail is slightly different from that for real-time conversation, because the picture-mail system operates in an off-line manner. One of most important factors in this system is how we encode/decode the signing motion pictures under the constraint of file size, time necessary for file transmission, and quality of decoded signing pictures. We also need to consider the situation that a user can play back slowly and repeatedly the signing pictures received, because the system works in an off-line manner. How these functions affect the intelligibility of the received message is one of important issues in designing a suitable picture coding method.

3.3 Intelligibility for Illustrations

Figure 3 shows another type of picture-mail system that utilizes illustrations for sign words. In this system, a user can send only a sequence of certain parameters for sign words: those parameters correspond to glosses in Japanese for the sign words. The receiver, that is usually a

PC, identifies the corresponding sign word and then outputs a sequence of illustrations of sign words. A PC has to have a certain kind of conversion table that enables a system to identify the sign word transmitted and to generate the sequence of sign word illustrations.

We have done certain experiments with deaf people on an intelligibility of sign illustrations. The experimental results show: (i) Deaf subjects can understand a sign word through its illustration when the illustration represents the sign they know. (ii) The sequence of illustrations conveys information enough to recognise the signed language sentence unless the order of illustrations (signed language word order) differs much from that they use everyday life. The later characteristics results from their language ability for signed language, which is common to spoken languages.

3.4 Features for Picture-Mail

In this section we show some interesting and useful features for picture-mail systems.

(1) Anonymity in communication.

Due to the modality of signed language, the style of signed language conversation /communication requires face-to-face setting. Certain versions of picture-mail systems provide certain degree of anonymity in signed language communication, because a sender does not need to appear on signed language sentences in those systems. The feature of those systems is similar to usual e-mail.

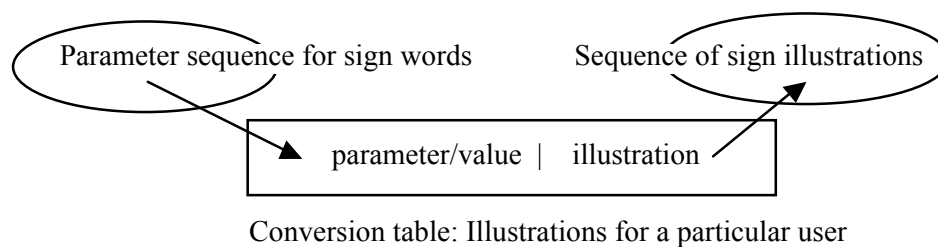


Figure 4. Conversion of sign words suitable to an individual.

(2) Variety of sign words.

As it is pointed out in Baker, & Cokely (1980), signed language has certain types of variations as same as other spoken languages. Among them is the variation in sign word: Deaf people who live in different regions use different sign words to represent the same meaning. Figure 4 shows one example for coping with the sign word variation by a conversion (parameter-to-sign illustration) table. The conversion table may have suitable sign word (illustration) to a particular user for each parameter value.

(3) Relay service.

Since the picture-mail system works in an off-line manner, an interpreter/translator at a relay service center does not need to interpret simultaneously. As mentioned earlier, there are two main forms in the service. One is that a person at the center translates received message into another message in a target language. When he/she receives written text he/she translates it into signed language with, for example, signing motion pictures, and send them to the receiver, or sometimes send back to the sender. The other one is the function of mode conversion: A translator rephrases, or explains in detail, the received message in another or the same mode. One example is that a sequence of illustrations is expressed by real signing and the movie is sent back to a user.

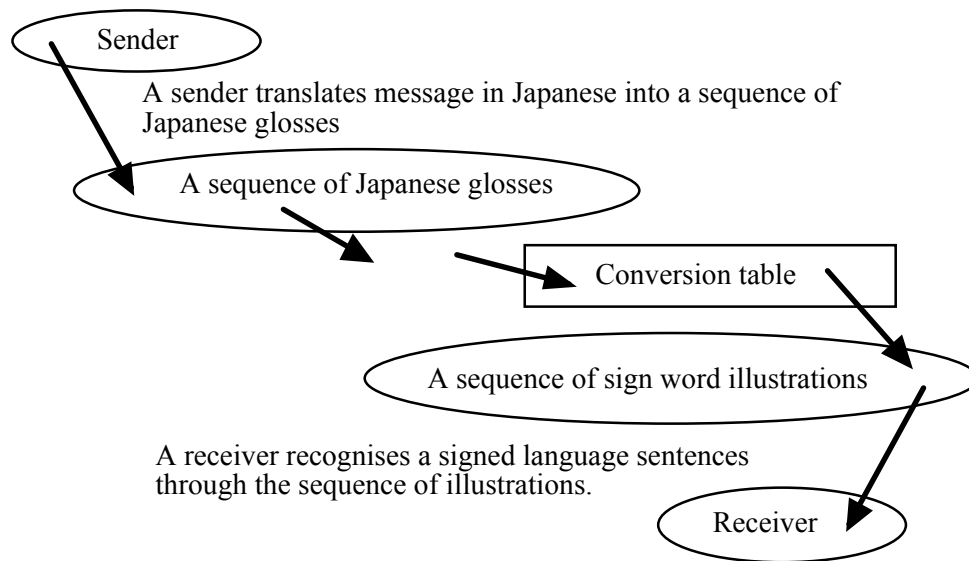


Figure 5. Translation between spoken and signed languages through picture-mail.

(4) Translation between spoken (written form) and signed languages.

Another interesting feature of the picture-mail system is shown in Figure 5. Where a sender translates his/her message into a sequence of Japanese glosses and sends it to a receiver. The receiver gets a sequence of illustrations for sign words. When the order of sign illustrations (word order) is good enough for the receiver, he/she can understand the message received. During the process above, the system including both the sender and receiver provides the function of language translation between the parties.

We can also extend the system so that the system can manipulate other languages: English in a written form and ASL (American Sign Language), Japanese in a written form and ASL if a user has certain knowledge for Japanese and ASL, and so on.

4. Concluding Remarks

In this paper, we have introduced certain kinds of e-mail based communication systems, picture-mail systems, that enabled users to use the medium of signed language for communications in an off-line manner over the Internet. We have first shown structural factors that specified picture-mail systems. Among them, we have focused on certain picture-mail systems that utilised: a movie file of real signing motion pictures; parameter file of illustrations for sign words. We have also considered some systems from both technological and human points of view. We have shown that the picture-mail system together with the parties realised some kinds of language translation function during the communication.

Although we have not discussed in this paper, picture-mail systems have certain applications such as distant signed language learning and distant signed language interpreter training, and so on. Certain preliminary investigations have shown the possibility of real use of these systems. There remains issues to be considered further: user interface and usability of the system; nonverbal components in signed language communication.

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