Visual language communication system with multiple pictograms converted from weblog texts

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Abstract: In this paper, we aim to build a new visual communication method for people who have religion, psychological, or linguistic difficulty, such as on/off-line foreign communication, face-to-face conversation between auditory challenged and other people, et al. We propose a communication method using expression of multiple pictograms. We implemented the Web server system that converts English texts into multiple pictograms based on morphological analysis. In the experiment, we examined the level of understanding, intuitiveness, and consent from the viewpoint of following three: (1) the chunk of pictograms as sentence, (2) clarity due to the difference in the linear order of the pictogram, and (3) the method of layout.

Key words: Multiple Pictograms, Visual Communication, Web expression

1. Introduction

In recent years, social infrastructures have been progressed by media, especially various Web architectures, and the opportunities of international communications are increasing. Now we can get important information or communicate with various network services, however, some information is provided in foreign languages. There are also Web services that translate the foreign language into the user's native languages, however the translation systems sometimes show unintuitive expression because of dictionary problems. On the other hand, world-wide communication has also advanced between people irrespective of age and gender. Nevertheless, people who have psychological burden for dense texts, such as children and elderly people, cannot comfortably or intuitively get information from some websites. Thus, not only in the international communications, but also in the website browsing that shows dense texts without any pictures, psychological burden for those people should be removed.

In order to enable an intuitive communication method for the people who have physical, psychological, or linguistic difficulty, nonverbal communication channels are expected to help their understandings. Moreover, the expressions on Web services consist of visual information. Consequently, we focus on "pictogram" as visual media of nonverbal communication.

Pictogram is one of visual symbols. It can simply represent a particular object, verb, or place by two different colors in a square simple picture as shown in Figure 1. The pictograms are used in public space such as stations and airports to intuitively tell general public some particular contents without any restriction of languages by visual pictures instead of text by written language.

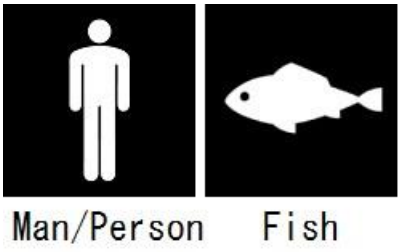

Figure.1 Example of Pictograms

In this paper, we propose a PHP-based on-line visual communication system that is accessible from any Web browser using multiple pictograms. Web can be considered as one of public space in on-line virtual environment. Any websites on the Internet are accessible from various people who have different backgrounds. Moreover, almost all of the information and communications on websites are visually provided. It is expected not only that the use of pictograms helps the user's understanding of the original contents with a tolerance level, but also that people, the author or the visitor of weblogs and social networking sites, enjoy their novel and unpredictable expressions.

Our proposed system converts a sentence into multiple pictograms; an appropriate pictogram for each word is selected based on the morphological analysis.

Our multiple-pictograms expression system adopts the conversion method for each word based on its word class. According to this method, it is considered that not only interactive communication such as conversation, but also one-sided communication such as weblogs and news articles are supported and developed by the easiness of producing the expression. Because this method can also accept texts that have been already existed on Web such as old news articles and literatures; it can convert past character media into multiple pictograms and the user can see the converted expressions. Thus, our proposing method promises the advantage when the user easily finds pictograms in the results rather than selecting from numerous pictograms in the catalog.

2. Related Researches

There have been many researches for communication using visual symbols. Okita et al. had proposed an application to support interactive non-verbal communication [1]. Hayashi et al. have also aimed to make communication by making sentences used visual symbol language, "PICS (Pictogram Ideogram Communication)", based on pictogram [2]. This research is the most nearest approach of our system, however, the purpose and the implementation were focusing on real-space communication. Contrary to the approach, we focus on the possibility of Web communication and its support.

There are also several researches applying pictograms or similar visual symbols for new type of expression and application. Usami et al. had implemented the system which expresses the outline of a sentence by a pictogram and its animation [3]. Munemori et al. had proposed and implemented a chat system that used pictorial symbols [4]. Fujita et al. had proposed an intuitive communication system used by pictogram on a mobile device [5]. The importance and usefulness of the pictogram expressions are insisted in these researches; however, the understandability has been discussed for long time. Ohta had proposed the visual language "LoCoS" which people can understand in common and regardless of nationality and age [6]. From these reasons, the understandability

and intelligibleness of the pictograms should be considered as one of the most important problems. We adopt a public-designed pictogram set for the intercommunity of the pictogram understanding.

Through the researches above, they had proposed or implemented the new visual language system with pictogram symbols for real communications. Although in the recent the Internet societies, people need the communication assistance for on-line uses. Still, there is not sufficient research that considers web-based communication such as web articles as proposed in this paper. Moreover, there is no research that examines presentation of visual symbols in detail.

3. System Implementation

3.1 System Concept

We implemented a Web-based conversion system from an English sentence to a line of multiple pictograms. The order of the pictograms is determined by a morphological analysis of the sentence. We select English language for the system's natural language input because there are many on-line translation systems from other language to English. Moreover, English is spoken in many countries as national language or second language.

3.2 System Structure

This system consists of input and output interfaces, a processing part working that include morphological analysis, and an image database that contains pictograms corresponding to each word class. We implemented the interfaces by HTML, and the processing part by PHP in order to make this system works as a totally on-lined system. The flow of this system is shown in the following Figure 2. The actual interface is just using the input of the texts from a form on HTML website, but the user can input a URL address for whole page conversion in future.

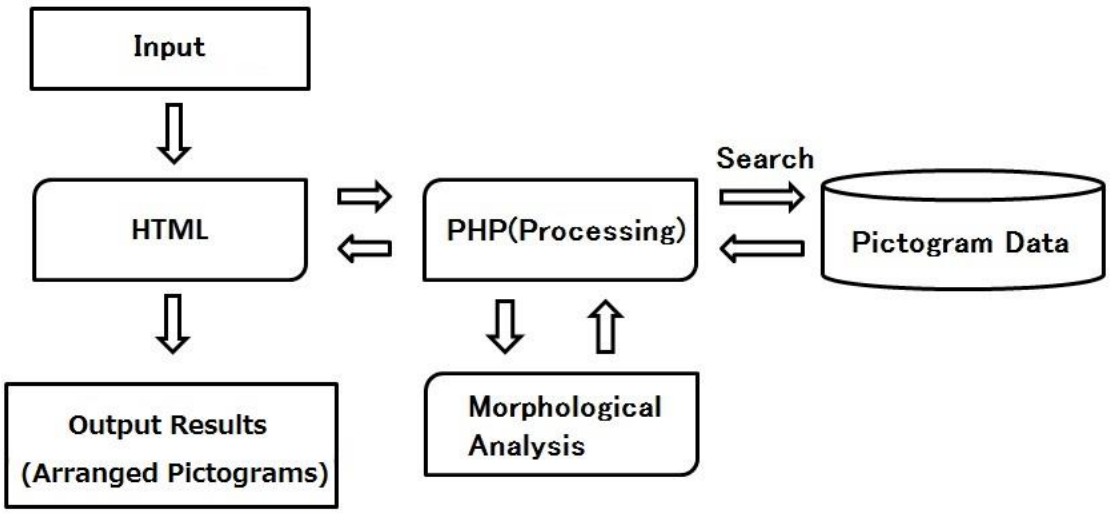

Figure.2 Conversion Process Flow of This System

First, a sentence entered text area is sent to the PHP program. In the PHP program, entered sentence is morphologically analyzed and the PHP program attaches the word-class tags for each word. Morphological analysis working as another PHP program separates the sentence by word and attaches tags about the part of

speech for each word. This implementation enables to replace differently in the same spelled words, which are used in different word class, into each appropriate pictogram. We adopted a very simple open-source program of the morphological analysis by Ian Barber in PHP/ir's website [7]. Multiple pictograms are appropriately selected corresponding to the word class and the meaning for each word in the image database. Our proposed system adopts a pictograms set of "Design principles pictorial symbols for communication support (JIS T0103)", that is the Accessible Design Foundation of Japan distributes free of cost. It is important for our proposed method to bring intelligible results using as common as possible. At the end, the image files with each appropriate pictogram for each word are sent to the browser interfaces, and the PHP program shows a line of the pictograms with the originally entered sentence as results.

3.3 System Operation

Here, we show an example of the system operations. This system's initial screen is shown in Figure 3. It has a form of the sentence. When the user enters English sentence and clicks "Translate" button, the multiple pictograms are appeared on the web browser as the result (Figure 4).

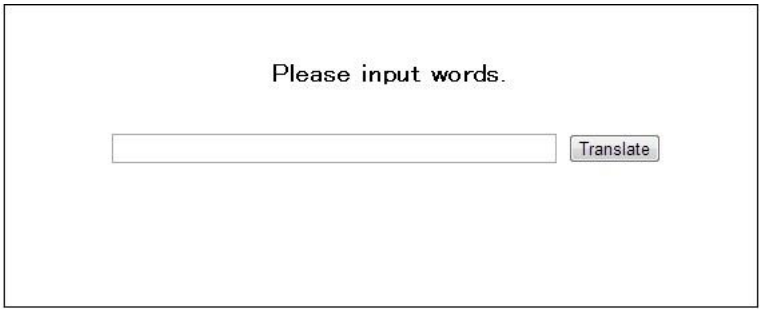

Figure.3 Initial Screen

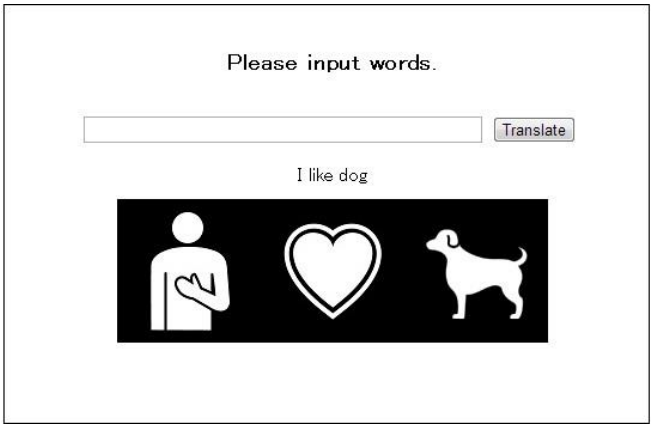

Figure.4 Result Screen

4. Experiments on Basic Understanding of the Multiple Pictograms

At first, in order to investigate the possibility and effectiveness of our proposing expression using multiple pictograms, we examined whether multiple pictograms obtain certain level of understanding or not. These

preliminary experiments should be discussed before the experiment how the expression with multiple pictograms converted from a sentence may affect on the on-line contents and their user's communication. Furthermore, we examined which kind of the arrangement for multiple pictograms can be intelligible; that is whether there is a difference by the layout of pictograms. As a result, we focused on the difference about level of understanding from following three points; (1) basic understanding of the sentence's expression with multiple pictograms comparing to English (that is *the second language* for the subjects), (2) the order of the pictograms in a line, and (3) the method of layout of the pictograms. Throughout the experiments, we measured he means opinion scores (MOS) as the subjective evaluation and the ratios of correct answers as the objective evaluation.

4.1 Experiment 1: Basic Understanding of Multiple Pictograms

In Experiment 1, we examined whether users can understand pictograms statement as a basis of the expression with multiple pictograms.

Experimental Subjects: We experimented with nineteen subjects who are early twenties and the undergraduate students in Faculty of Informatics.

Experimental Procedures: We prepared three conditions for this experiment: a) only a line of pictograms, b) English sentence, c) and pictograms with English subjoinder. Three contents of the sentences are constructed by SV sentence pattern or SVO sentence pattern. The experimenter varied the combinations between three conditions and three contents of the sentence. The subject translated each sentence into their natural language for each condition with different contents. Then the subject evaluated the relevance for the following statements in five-point scale (5: relevant, 4: somewhat relevant, 3: even, 2: somewhat irrelevant, 1: irrelevant); Q1) the level of understanding of presented sentence, Q2) you were able to read presented text sensuously, and Q3) you were able to understand presented sentence quickly. The Furthermore, after letting them answer three questions, we presented each model answers in their natural language, and let them answer to the following statement: Q4) you could confirm a consensus level compared with their answers. After all the rating, the subject asked to give a free description on the pictograms' expression. All the conditions are counter-balanced. We explained to the subject a precaution statement. After that, we conducted assessment experiment taken along each experimental procedure.

Experimental Results: Table 1 shows the ratio of correct answers for each condition. The highest result of correct answers was found in the condition of "Subjoinder". The next result was the condition of English texts expression, and the sentence with only the pictograms scored lowest. However there was no difference so much in the percentage of each word compared with text. Figure 5 to 7 show the results of the subjective evaluations with the ANOVA test result with star (*) marks.

From these results, we could confirm that there is a significant difference between the sentence with only the pictograms and other two types in level of understanding, understanding quickly and consensus. And we found that it is not easy to convey correct understanding from the pictograms' sentence comparing with only written by language and subjoinder. This may be thought that presented sentence was too short to understand for the speakers as the second language. It is possible that the pictograms' sentence is easier to understand if the presented text was much longer as a second language, complicated or unknown language at all for subjects. In addition, it is considered that the skill level of their English saw to some extent high because the subjects were the undergraduate students in university. Thus, we should examine for elderly people or children of low proficiency of the language.

Table 1. Ratio of Correct Answers in Experiment1

Pattern	Text(%)	Each Word(%)
Subjoinder	98	99
English Text	91	96
Pictogram	68	88

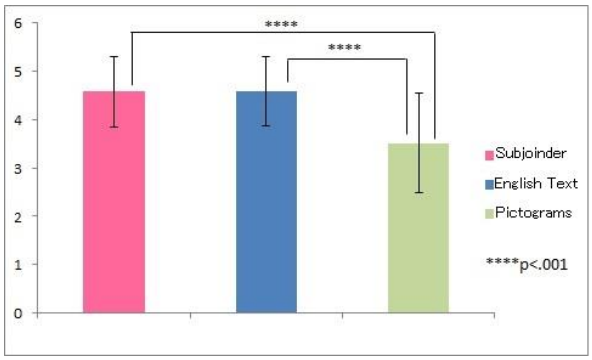

Figure.5 Level of Understanding

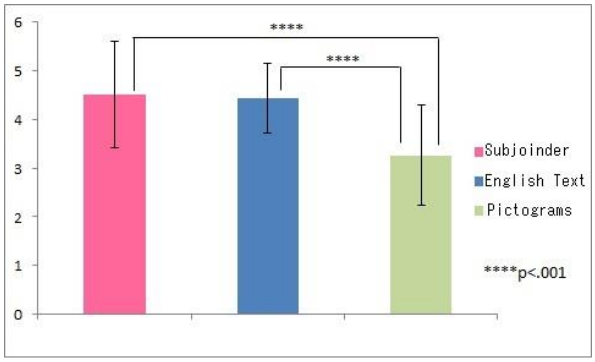

Figure.6 Understanding Quickly

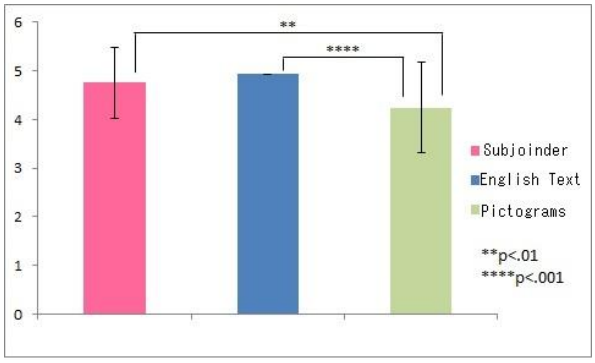

Figure.7 Consensus

4.2 Experiment 2: Order of Pictograms in a line

In Experiment 2, we examined the difference about level of understanding the order of pictograms by making comparison among the order of Subject, Verb, and Object (SVO arrangement type, see Figure 8), the order of Subject, Object, and Verb (SOV arrangement type, see Figure 9), and the random order (see Figure 10) arranged in a line.

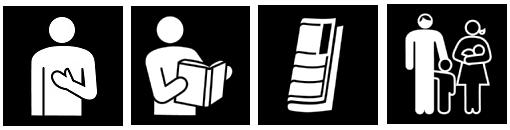

Figure.8 SVO Type in Experiment 2

Figure.9 SOV Type in Experiment 2

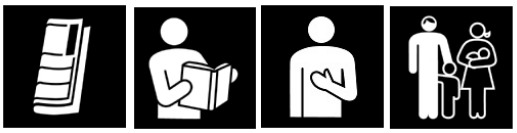

Figure.10 Random Order in Experiment 2

Experimental Subjects: We experimented with nineteen subjects who are early twenties and the undergraduate students in Faculty of Informatics.

Experimental Procedures: We prepared three different of sentences constructed by four pictograms; SVO type, SOV type, and random order. The experimenter varied the combinations between three conditions and three contents of the sentence. The ratio of the correct answer and the subjective evaluation had been conducted with counter-balanced repeated measurements. The subjects were instructed to see the pictograms in a line for each condition. After a glance, subjects were asked to translate the total meaning of the pictograms and each single pictogram into their native language. After the translations, the subjects intuitively evaluated the impression of the relevance to the statement as follow; Q1) you were able to read the presented sentence sensuously, Q2) you were able to read the sentence understandability. After two subjective evaluations in five-point scale, we showed a model answer, and asked them to evaluate the consensus level of the contents by the statement; Q3) you agree with the model answer compared with your own translation.

Experimental Results: Table 2 shows the ratio of correct answers for each condition in this experiment. The total results were not high with these contents while the correct translation was sufficient high scored for each word. From these results, it is considered that it is difficult to understand sentence-like expression constructed by pictograms.

The results of the subjective evaluations did not show any significant difference by the conditions, however, there was a significant difference among the contents. Therefore, it is conjectured that there is no difference of

level of understanding the order of pictograms in this experiment with Japanese subjects. We should care that these results were come out from the characteristics of the native language for the subjects. Japanese allows various orders of the word classes beyond the basic rule of the order as like SOV. It is assumed that the subjects have been accustomed to understand the word sentences in various orders. The possibility should examine with the other people who talk different native languages in order to clarify the necessity of the grammatical order of the pictograms.

Table 2. Ratio of Correct Answers (Accuracy) in Experiment 2

Type	Text(%)	Each Pictogram(%)
SVO Type	26	74
SOV Type	28	76
Random	28	78

4.3 Experiment 3: Method of Layout of Multiple Pictograms

In Experiment 3, we examined the different level of understanding by the arranging method of pictograms.

Experimental Subjects: We experimented with nineteen subjects who are early twenties and the undergraduate students in Faculty of Informatics.

Experimental Procedures: We prepared three pictogram sentences constructed by four pictograms to compare the three conditions of the arrangement; placement in a line (Figure 11), T-shaped placement (Figure 12), and squared placement (Figure 13). The contents of the sentence are SVO sentence pattern or SVOO sentence pattern.

T-shaped placement adopts the arrangement with connecting the verb with its subject and multiple objects; the subject is placed into the left side of the verb, the first object (Object1) is placed into the right side, and the second object (Object2) is placed at the bottom side. The connection should be considered for not only the subject and the objects but also modifying word such as adjective at the bottom side (see Figure 12).

Squared placement adopts the arrangement using four corners. This placement arranges the subject of the sentence on upper left, verb on upper right, the first object on the left below, and the second object or modifying word on below right (see Figure 13).

Figure.11 Placement in a line(SVOO)

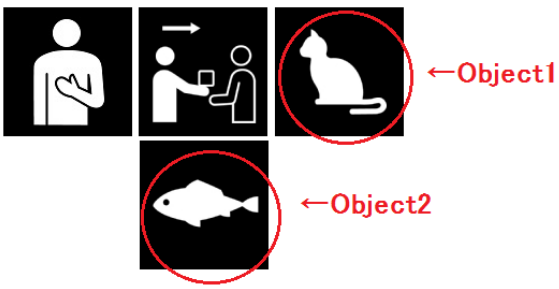

Figure.12 T-Character like Placement Connecting Verb and Objects

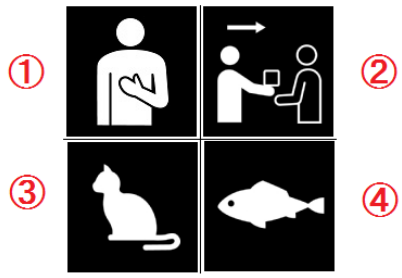

Figure.13 Squared Placement

The experimenter varied the combinations between three conditions and three contents of the sentence. The ratio of the correct answer and the subjective evaluation had been conducted with counter-balanced repeated measurements. We instructed the subjects to translate the sentence and each word into their native language for each condition. After each experiment, the subjects evaluated, relevance of the following statements in five-point scale; Q1) you were able to read the presented sentence sensuously and Q2) the presented sentence was understandable. After the evaluation for two statements, the experimenter showed Japanese model answers. Finally we asked them to evaluate the consensus level of contents by the statement; Q3) you agree with the model answer compared with your own translation.

Experimental Results: Table 3 shows the ratio of correct answers for each condition in this experiment. Lined placement was the highest ratio of correct answers without any differences between T-shaped placement and the squared placement. On the other hand, the translations of each word were highly succeeded.

Table 3. Ratio of Correct Answers (Accuracy) in Experiment 3

Placement	Text(%)	Each Pictogram(%)
Lined	44	79
T-Shaped	30	75
Squared	30	74

Figure 14 and 15 show the results of the subjective evaluations for the statements. There were significant differences between the lined placement and other two types of arrangement in both understandability and intuitive reading. These results are similar to the objective evaluations.

From both results of the subjective evaluations and the objective evaluations, it is found that the lined placement is most comprehensive among three conditions. It is assumed that the lined placement like horizontal line written language is easy to understand. It is conjectured that the accustomed way of reading and writing sentences are used in this experiment. It is also suggested that the difference of the arrangement can lead different levels of understanding.

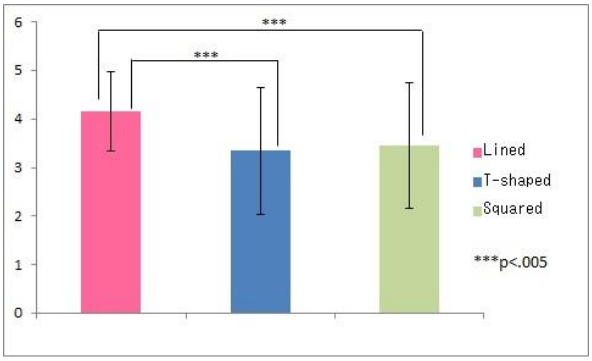

Figure.14 Understandability by Different Arrangements

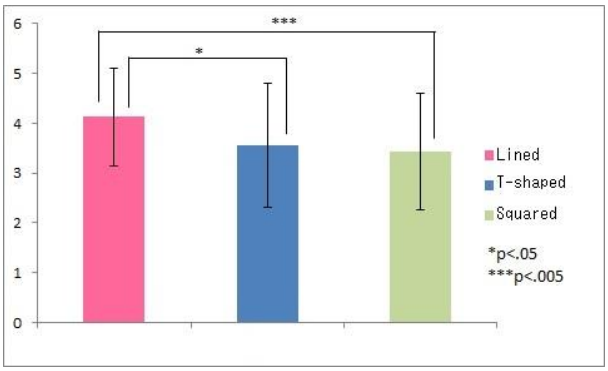

Figure.15 Intuitive Reading by Different Arrangements

5. Discussions

Although the sentence of the natural language is understandable compared to the pictograms as we expected, the multiple pictograms can show a certain level of the intelligibleness. It is considered that the skill level of their English was to some extent high because the subjects were the undergraduate students in university. We have to conduct the same evaluation for elderly people or children of low proficiency of the language. It is also assumed that the pictogram's sentence can become easier to understand if the presented texts were written in unknown language for subjects.

Next, there were the results which can be simply summarized from Experiment 2 and Experiment 3; that is, the most easily comprehensive expression of the sentence using multiple pictograms is the lined placement in any order for the subjects in the experiments. From the results of Experiment 2 without any significant difference by the order of pictograms, there are two possible reasons; the first one is the Japanese subjects; Japanese language allows skipping the grammatical order. The second possibility is the common recognition process for any foreign people. We have to verify the reason by examining similar tests for people who talk different native languages in order to clarify the necessity of the grammatical order of the pictograms. If the latter possibility is confirmed, it is considered that the system is applicable also to the foreigners' communications in the actual order of the words.

In the future, we need several verifications using long sentences, complicated sentences, or unknown foreign languages comparing to the pictograms sentence. It may be also considered the experiment for foreigner subjects. Furthermore, we should verify many kinds of the modifying words, such as time and place. We have implemented a replacement system of the sentence from a nonexistent pictogram of a particular object to one of typical results in on-line image search engine. In order to advance such implementation, it is necessary to show demonstration

experiments in practical use, such as an application for web pages by a pictogram into the view (see Figure 16). Differently from real communication, on-line communications are highly supported for international people accessibility in terms of an infrastructure. Web pages are browsed by many people who have various nationalities, generation, and disability. If there could be a Web page written by pictograms, the new communication style may appeared in future; for example the multiple pictograms can show the Web page's context by their para-linguistic expression. Difficulties of communication during outing will be also helped by the on-line conversion system through the ubiquitous service with advantages of "always, anywhere, and anyone."

Today, I went to a restaurant with father and mother in the afternoon.
I was happy to eat delicious food and drink delicious liquor.
In the evening, I sang a song, but my mother scold me "Be quiet." and I disappointed.
Tomorrow, I will draw a bird, go to a movie theater, and drink delicious tea in a cafe.

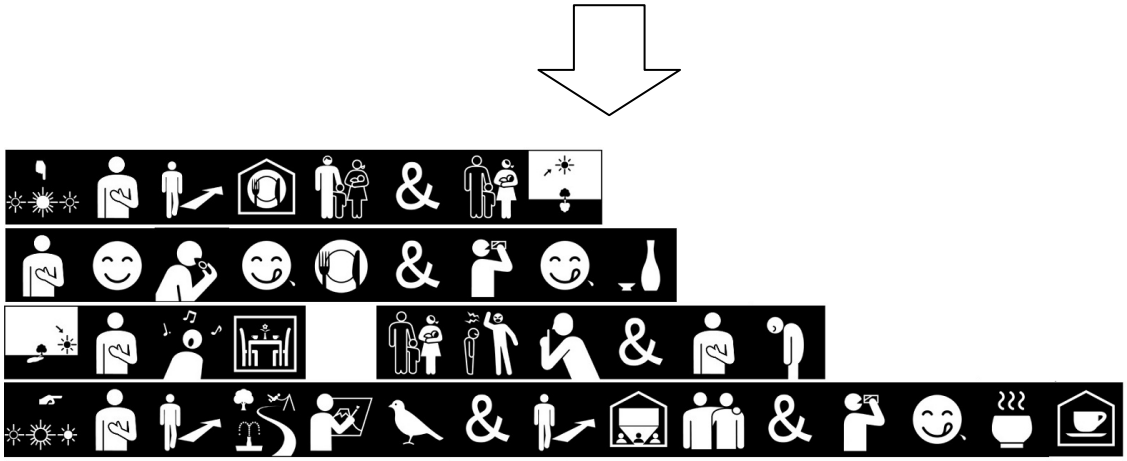

Figure.16 Example of Webpage Converted from Weblog to Multiple Pictograms

6. Conclusion

In this paper, we proposed a visual communication method by multiple pictograms. We verified whether our proposed usage of the pictograms provides a certain level of understanding. As the results, we found that the expression of the sentences consisting of only pictograms, was recognized over ninety percentage of all of sentence in the first experiment, and understood over seventy percent of each single pictogram in the subsequent experiments, although the understanding level was not so high compared to the natural languages. Thus, it was conjectured that the "Pictogram Sentence" could be effectively used for the fuzzy communication, or novel style of communication. In the future, we plan to study "Entertaining Communication". Therefore, we plan to evaluate the possibility of the unexpecting, surprising, and enjoyable aspects of the proposed method.

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