MOTION DESIGN USING MIMETIC WORDS

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ABSTRACT
We are developing a methodology aimed at the design of new forms of motion that are more attractive to the human mind by blending motions obtained by mimicking the movement of natural objects. In this methodology, we focus on mimetic (reality-symbolic) words. Mimetic words express appearance and movements and can be understood as potential representations of those motions that are difficult to describe verbally. In this study, our objective is to create extremely creative and emotional motions from newly expressed mimetic words; just as new music is created from unique scores. First, we develop a method to decompose a newly expressed mimetic word into known mimetic words and actualise this method in the form of a tool. We then propose a procedure for creating a new motion from a newly expressed mimetic word.

INTRODUCTION
Nowadays, concomitant with the many forms of expression currently available, new dynamic forms of expressions are appearing in various fields. For example, on the Internet, logos employing computer-generated graphical movements and sounds that are used to advertise products or corporations are very abundant. Hence, the field of design has come to address these dynamic and impressive objects. In this context, our objective is to design an emotional motion that resonates with deep feelings. This motion should be applicable to animated logos to make them more attractive.

Music, another form of dynamic expression, can make a deep impression on us. Music differs from natural sounds in that it is a man-made creation and evokes feelings that go beyond ordinary human imagination. In this context, we assume in this work that a creative motion that goes beyond the ordinary human imagination can produce emotional impressions that resonate with deep feelings. Here, the term ‘emotional impression’ suggests an active impression evoked in the subject; something that touches deep feelings in the human mind, while the unadorned term ‘impression’ suggests a passive or static impression.

On the basis of the above considerations, a method for designing a creative and emotional motion along with a computer system for its implementation was developed in our previous studies [1, 2]. A new motion can be generated by blending motions obtained by mimicking the movement of natural objects. However, it is difficult to verbally describe a motion that does not yet exist, but that nevertheless resonates with deep feelings.

To create new motions that resonate with deep feelings, we focus on mimetic words in the Japanese language. Onomatopoeic (sound-symbolic) words, for example, ‘pon’ (pop) and ‘kachi-kochi’ (tick-tock) imitate actual sounds, while mimetic (reality-symbolic) words, for example, ‘shiku-shiku’ (sobbing) and ‘kune-kune’ (wriggling), express appearance, movement, feeling, and other phenomena and can be understood as verbal representations of such images that are difficult to describe. We believe that mimetic words are capable of expressing deep feelings; further, they can function similar to musical scores, by which new music is created. On the basis of these considerations, we created a database of motions that we related to corresponding mimetic words [3, 4]. A total of 160 motions were obtained by capturing a video of a natural object and were related to nine mimetic words identified as representative mimetic words to these motions. The database helps a designer to express the image of the motion that is stored in his/her mind.
In this study, our objective is to create extremely creative and emotional motions from newly expressed mimetic words; just as new music is created from unique scores. Sometimes, people not only use known mimetic words to express their ideas but also create new mimetic words by themselves to express their perceptions or ideas.

**AIM AND RESEARCH METHOD**

Our aim is to develop a method by which a new motion can be created from a mimetic word newly expressed by a designer. Even newly expressed mimetic words are assumed to be based on existing mimetic words. Accordingly, we attempt to decompose a newly expressed mimetic word into known mimetic words. First, we investigate the forms or structure of mimetic words. On the basis of this investigation, a method by which a newly expressed mimetic word can be divided into known mimetic words is developed. In order to support the decomposition process and search for a motion that is stored in the database on the basis of mimetic words, we constructed a database of mimetic words corresponding to motions. This database stores conventional mimetic words and elements of their meanings.

**THE MOTION DESIGN METHOD**

In our previous studies, we developed a method by which creative and emotional motion that resonates with deep feelings can be generated [1, 2]. The method was constructed on the basis of the following strategies:

**Mimicry of Natural Objects:**
Humans have created many artefacts based on or suggested by natural objects whose movements are both unique and charming [5]. Therefore, we decided to use natural objects as our source for designing a creative and emotional motion. Hereafter, the motions obtained by mimicking natural objects are referred to as ‘base motions’.

**Emphasis on Rhythmic Features:**
In order to generate a more creative motion that extends far beyond the human imagination, we emphasise the rhythmic features of motion. Rhythm in music involves, in part, an interrelationship between the accented (strong) and unaccented (weak) beats [6]. Accents that are produced by stress (dynamics) imply the dynamic intensification of a beat—that is, an emphasis implied through the use of a louder sound. We emphasise the rhythmic features of a motion by increasing their intensity.

**Blending of Motions:**
According to studies on design creativity, concept blending is crucial to the creative generation of concepts [7]. Concept blending is based on combining two input concepts to yield a third concept. Although a blended concept inherits part of its structures from the input concepts, it also includes emergent structures of its own. We applied the notion of concept blending to the design of a creative and emotional motion and developed a method of blending motions generated by mimicking natural objects.

The proposed method was actualised in the computer system shown in Fig. 1. This system is called ‘Motion Generating Tool’. First, base motions are obtained by mimicking natural objects. Second, the rhythmic features of these motions are emphasised. Third, the rhythmic features are blended, and a new motion generated.

**Database**
In order to help a designer to describe an image of a motion verbally, we created a database of base motions with corresponding mimetic words [3, 4].

The base motions were extracted from various kinds of natural objects by means of a tool that obtains motion data by capturing a video of a natural object and extracting its movements. A total of 160 base motions were collected using this tool. The base motions were obtained from several categories of fish and aquatic living things, reptiles and amphibians, birds, mammals, plants, and insects.

The base motions obtained were associated with the corresponding mimetic words according to the following procedures: First, referring to the Dictionary of Japanese Onomatopoeia [8], we chose mimetic words that are generally used. Second, we classified mimetic words based on the categories of the words. According to the EDR Electronic Dictionary [9], verbs are classified into five categories: movement, change, appearance, action, and phenomena.

![Figure 1. OUTLINE OF THE MOTION GENERATING TOOL](image)
Consequently, we chose 52 mimetic words. Third, the 52 mimetic words were classified into categories. In the classification, eight college students were shown a video of a natural object and a list of mimetic words. They were then asked to relate each movement (video) to the 52 mimetic words. Finally, a cluster analysis was conducted and nine representative mimetic words were identified—specifically, hira-hira (fluttering, swirling), noso-noso (moving slowly, clumsily), bata-bata (moving busily in small motions; flapping), choko-choko (walking or running with short steps, restless and constantly on the move), une-une (winding, meandering), suwa-suwa (something soft and light swells up or rises), sui-sui (moving smoothly and easily through something), yusa-yusa (swaying of something large and heavy), and pyon-pyon (hopping or skipping agilely).

The nine identified representative mimetic words (hereafter, referred to as ‘headwords’) were then related to the 160 base motions.

By incorporating the database of base motions related to the corresponding mimetic words, we extended the Motion Generating Tool, as shown in Fig. 2. A designer can retrieve base motions in accordance with his or her imagination from the database by using classified mimetic words as keywords. From the selected base motions, the Motion Generating Tool generates a new motion by blending the base motions and shows the new motion to the designer. In the Motion Generating Tool, the parameters for emphasizing and blending (i.e., thresholds and weights) are determined according to the designer’s individual criteria. If the designer wants to modify the newly generated motion, he/she can revert to a former selecting or blending process.

**METHOD OF DESIGNING NEW MOTIONS FROM NEWLY EXPRESSED MIMETIC WORDS**

In this study, our objective is to develop extremely creative and emotional motions from newly expressed mimetic words; just as new music is created from unique scores.

**Characteristics of Mimetic Words**

Virtually all human languages have their own onomatopoeic (sound-symbolic) and mimetic (reality-symbolic) words; however, Japanese, in particular, has many and various varieties of onomatopoeic and mimetic words [10]. Onomatopoeic and mimetic words are one of the most fundamental, characteristic, and lively aspects of the Japanese language [11]. They are completely standard, and for native Japanese speakers, many concepts cannot be expressed clearly without these words. Despite this, however, these words are often considered by native speakers of English to be childish or informal.

Japanese has many mimetic words that represent the situation of things moving or being moved. One reason for this is that, while English often concentrates meaning in verbs, in Japanese, more meaning is conveyed by nouns, adjectives, and adverbs [12]. For example, the many verbs used in English to describe rotate, such as turn, round, spin, and twirl. Each of these words has a distinct meaning. In Japanese, such nuances of meaning are conveyed differently. Japanese appears to use fewer verbs than English, and the verbs themselves often express less specific meaning than English verbs do. Japanese speakers express subtle nuances of meaning by choosing mimetic words, or they often coin new mimetic words that extend from their original meaning.

Accordingly, our aim is to develop a method by which new motions can be designed from newly expressed mimetic words on the basis of the research into Japanese mimetic words.

**Types**

The forms of known mimetic words were investigated as follows. Many linguists focus on the relationship between the sound of a word and the meaning of that word [11–14]. According to them, mimetic words are classified into the types described below (here, C = consonant; V = vowel; Q = syllabic obstruent; and = long vowel):
(1) Reduplications [CVCV-CVCV]
   E.g., ‘fuwa-fuwa’: something soft and light swells up or rises.

(2) CVCV RI
    Ending in ‘ri’ sound (e.g., fuwaRI).

(3) CVCV N
    Ending in syllabic nasal (e.g., fuwaN).

(4) CVCV Q
    Ending in choked sound (e.g., fuwaQ).

(5) CVCV ::
    Ending in long vowel (e.g., fuwa::).

These five types have been identified as the basic forms of known mimetic words. Types (2) to (5) sometimes appear with type (1) reduplication; for example, fuwaRI-fuwaRI and fuwaQ fuwa::: Moreover, all the types can appear in combination with each other.

On the basis of the above classifications, we determine the stem of a mimetic word as XY (e.g., fuwa). Here, X is the first mora of a word and consists of one consonant (C1) and one vowel (V1), e.g., fu. Y is the second mora comprising C2 and V2, e.g., wa. By extracting the stems of a newly expressed mimetic word, the new mimetic word can be decomposed into known mimetic words.

Extraction of the Stem of a Mimetic Word
We developed a tool to extract the stems of mimetic words from a newly expressed mimetic word based on the above identifications. The tool comprises the following steps:

Step 1) Halve the inputted newly expressed word.
Step 2) Examine the halved inputted word to determine whether its type is reduplication. If yes, go to Step 4.
Step 3) Divide the inputted newly expressed word into segments at the places where [RI], [N], [Q], and [:] are found.
Step 4) Remove [RI], [N], [Q], and [:] from each segment.
Step 5) The remaining parts of the segments are the stems.

An example of the extraction done using the tool developed is depicted in Fig. 3.

Procedure used to Create a New Motion from a Newly Expressed Mimetic Word
We propose a procedure for creating a new motion from a newly expressed mimetic word. This proposed procedure is outlined in Fig. 4:

Step 1) The stems of a newly expressed mimetic word are extracted using the tool discussed in the previous subsection.
Step 2) Known mimetic words that have the same stems as the new mimetic word are sought from the database of mimetic words. If no known mimetic words that have the same stems are found in the database, a further search is attempted to find
mimetic words that have similar properties (i.e., meaning or sound).

Step 3) The headwords most associated with properties (i.e., meaning or sound) similar to that of the known mimetic words searched for in Step 2 are identified.

Step 4) Base motions corresponding to the headwords identified in Step 3 are retrieved from the database.

Step 5) The base motions retrieved in Step 4 are blended by using the Motion Generating Tool shown in Fig. 1.

EXAMPLE

As an example of our challenge, the generation of a motion from a newly expressed mimetic word is presented in this section.

Imagine a situation in which a new mimetic word ‘batanoshin’ is expressed for a new motion. ‘batanoshin’ was decomposed into ‘bata’ and ‘noshi’ by the developed tool. Here, bata-bata is a headword that is stored in the database, while ‘noshi’ was found to be similar to the headword noso-noso. Base motions corresponding to bata-bata and noso-noso were therefore retrieved from the database. As shown in Fig. 5, among the retrieved base motions, three base motions for each of the headwords (bata-bata and noso-noso) were then selected by us. The selected base motions were then emphasised and blended to generate a new motion. Finally, the generated motions were transferred into a logo. The logo consisted of three parts, and the three newly generated motions were transferred to each part of the logo. In this example, a newly generated motion, which was obtained by blending base motions extracted from a hamster and a penguin, was transferred to the upper part. Similarly, a motion obtained by blending base motions extracted from an eagle and a tiger was transferred to the middle part, and a motion obtained by blending base motions extracted from a beetle and a spider was transferred to the lower part. The motion generated for the logo is shown in Fig. 6.

CONCLUSION

In this study, we proposed a method for creating a new motion from a mimetic word newly expressed by a designer. First, we developed a method by which a newly expressed mimetic word can be decomposed into known mimetic words. On the basis of our investigation into the forms and structure of mimetic words, we then developed a tool that divides a new mimetic word into known mimetic words. We then proposed a procedure that creates a new motion from a newly expressed mimetic word.
We used the design of an emotional motion created by combining two motions from a newly expressed mimetic word as a case study.

REFERENCES