

# Mnemonic-Based Interactive Interface for Second-Language Vocabulary Learning

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**Abstract** – In this paper, we propose a new educational system for second-language vocabulary learning based on a mnemonic technique. The system is equipped with the dynamic and interactive interface that allows vocabulary learners to seamlessly browse a collection of foreign words while suggesting phonetically related words of a known language for helping the memorization of unfamiliar languages. The phonetic algorithm is employed to encode pronunciation of words. The phonetic codes of words are then applied to homonyms of different languages (i.e., known and learning languages). The Levenshtein distance is used to quantify the similarity of phonetic codes or of words' pronunciation. The mnemonic words with their associated images are presented surrounding the learning words according to the edit distance or phonetic similarity. With visual effects based on user's input, the dynamic and interactive interface will help users browse a collection of vocabulary in source and destination languages as well as images related to their word meanings.

**Keywords** : Mnemonic, CALL:Computer-Assisted Language Learning

## 1. Introduction

Learning a new language is often a matter of using memory techniques, for example, to remember its grammar, syntax and contextual usage of words, and combining them together. One of the keys to successfully acquire the ability to comprehend a new language is to learn its vocabulary, comprising words meaning, spelling, and pronunciation and so on.

However, the vocabulary learning requires considerable effort for associating words in foreign languages with learner's own language. Thus, many computer-assisted learning techniques have been proposed for effective words organization, semantic mappings and mnemonics. Recent research interest in language learning is to use a mnemonics technique for helping the retention of complex foreign vocabulary; however, there is little discussion on an interactive system based on the mnemonic technique for vocabulary learning, and common way to generate mnemonic words is a manual selection from dictionaries by learners or teachers.

Therefore, we propose a new interactive educational system for second-language vocabulary learning based on a mnemonic technique for reducing learner's cost of understanding words and finding

associated words. The mnemonic word generation is achieved by the three algorithms, Link system, phonetic algorithm and Levenshtein distance while the interactive visualization of the generated words with images is provided by D-Flip (Dynamic, Flexible and interactive Photoshow) [7]. The system with the dynamic visualization allows learners to seamlessly browse collection of vocabulary words with related images while phonetically associated words and images in own languages are dynamically suggested in the screen. This image-based mnemonics technique is expected to provide a fast, easy and enjoyable learning style. In this paper, we implemented a prototype of mnemonic-based interactive vocabulary learning system, and evaluated it by comparing with traditional learning ways.

## 2. Mnemonic-based interactive learning system

Generally, language learners and teachers have to generate mnemonic words manually to support their memorization. There is no method that automatically creates mnemonic words using phonetic algorithms. We proposed a mnemonic-based interactive vocabulary learning system based on the following four algorithms. The automatic generation of the mnemonic words and their link are achieved by Link system, phonetic algorithm and Levenshtein distance while the interactive visualization of the generated

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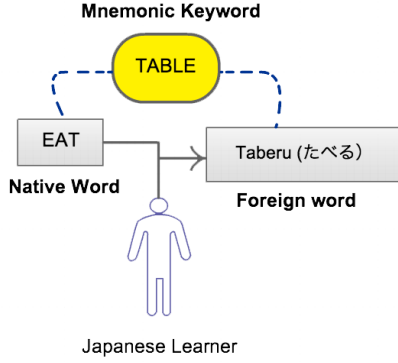


Fig. 1: The link system method of mnemonic learning strategy.

words with images was provided by D-Flip algorithm.

### 2.1 Link system for mnemonics

Mnemonics are a powerful learning strategy in specific vocabulary learning<sup>[6]</sup>. Atkinson et al.(1972)<sup>[2]</sup> reported evaluating the effectiveness of a mnemonic procedure, called the keyword method, for learning a foreign language vocabulary that mnemonic strategy can improve recognition and recall in a variety of conditions. Amiryousefi and Ketabi (2001)<sup>[1]</sup> demonstrated that including mnemonic technique into the classes are useful ways of enhancing vocabulary learning and recall. Link System is the one of the mnemonic method that improves learner’s memorization of foreign vocabulary by creating word association between foreign language and learner language.<sup>[3]</sup>. Link System is the one of the mnemonic method that improves learners memorization of foreign vocabulary by creating a word association between foreign language and learner language.

In figure 1, the keyword “Taberu” in Japanese have a similar sound with the “Table” in English. As a result, The learner thus provides the sentence that link mnemonic keyword with the foreign word. Example: The Japanese word for Eat is Taberu. Imagine You “EAT” your lunch on the “TABLE”.

This is a basic idea for mnemonic-based vocabulary learning system, bringing some technical challenges, for example, how to generate similar pronunciations words from the two languages and how to visualize them in a seamless and interactive way. The following algorithms aim to solve these challenges.

### 2.2 Phonetic Algorithm

Index words using their pronunciations by different codes based upon algorithms used. In order to

make the link system, phonetic relations of words from different languages based on their pronunciations must be organized. We used Soundex that is a phonetic algorithm for indexing words by sound. Here, homophones of two words are encoded to the same representation so that they can be matched despite minor differences in spelling<sup>[4]</sup>.

### 2.3 Levenshtein distance

The common approach to comparing word similarities is using a string metric for measuring the difference between two sequences or Levenshtein distance<sup>[5]</sup>. This method is counting the minimum number of insertions, deletions and substitutions of single characters required. For example, between “Interaction” and “Interactiion” the Levenshtein distance is 1.

### 2.4 D-Flip

D-Flip (Dynamic Flexible Interactive PhotoShow) is an interface for interacting with a large set of photographs<sup>[7]</sup>. In this interface, each image is always moving like living objects, and their layout can be dynamically arranged by user’s input (e.g., selection, drag, and deleting). Basically, an initial stage of D-Flip displays all imported images without overlapping each other in a viewport by automatic rearranging and resizing images based on local collision detections. One of images can be selected and enlarged by a cursor where surround images around the enlarged one are automatically re-arranged so that all images are displayed in the viewport. Images can be grouped and arranged not only by their embedded meta-data, but also by their extracted image features such as color variances. Examples of the meta-data include time and location when they were taken. This information can be used for the real-time arrangement of photo collections. For instance, a user can gather related images around the focused one, and then analyze a mapping of photos using either timeline or location map. These basics interaction provides attractive and enjoyable visual effect by the moving images during natural and ordinary cursor operations.

### 2.5 System integration

We use Google custom search API to prepare the appropriate images for the 400 most frequently used noun words. The proposed system imports the prepared images and organizes them with displaying some captions about mnemonic words in a dynamic



Fig. 2: Initial state of Mnemonic-Based interactive interface, an image is focused by overlaying a pointer and the use can browse to see every photo that interested

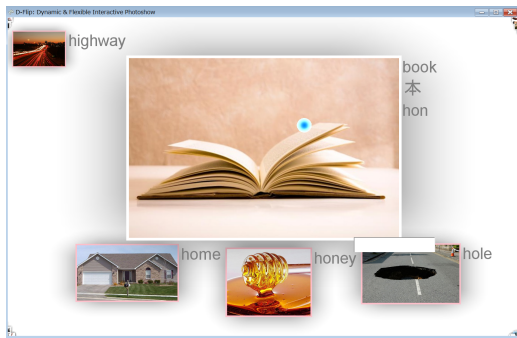


Fig. 3: An example of given the mnemonics words of “Hon” including home, hole, honey and highway and flexible interactive way. Here, learners can interact with word collections in two ways, scanning words freely or searching for the target word in the search box. In the initial stage of the scanning mode, many slightly moving images pack the entire screen. If an image is selected by a cursor, it will get larger with displaying captions about words. Simultaneously, the phonetically similar words will gather around the selected image based on the phonetic algorithm. This interaction contributes that learners remember the foreign word’s pronunciation and keep understanding their associations.

### 3. Experimental Methodology

In order to evaluate the implemented system, we conducted a pilot study with a controlled scenario for teacher. We had three systems to be compared in this study, including traditional paper work, static visualization of the related words and the implemented mnemonic-based interactive interface. The main interest of this study is to explore if the mnemonic-based interactive interface helps user to find mnemonic vocabulary more easily than using traditional paper dictionary based methods, and more satisfied than using static visualization of the

word suggestions.

Six participants ranging from 22 to 35 years old from the local university were required for the study, and we checked that they understand both Japanese and English. They sat in front of 27-inch monitor (2560x1440 resolution) and used a mouse to interact with the dynamically displayed images.

We prepared randomly chosen samples from 500 most frequently used noun words for this study. For the traditional way, the participants had to find mnemonic words manually to support their memorization from the English dictionary. For the static visualization system, mnemonic words are automatically created by Link system, phonetic algorithm and levenshtein distance but images are statically displayed without any special interaction. For mnemonic-based interactive interface, user can manage all images in an enjoyable and visually pleasant way where learners easily find related words by automatic suggestions or using a search box.

#### 3.1 Test Collection

- **Candidate mnemonic vocabulary** Top 500 words from frequently used noun words
- **A query set** A set of simulated search tasks. Six words was given as task from a randomly chosen sample from 500 most frequently used noun words.
- **Ground truth data** Create from language teachers, who use mnemonic techniques for teaching language to students. Judge mnemonic English words suggested by the systems using graded relevance, according to their preferences.

#### 3.2 Task Design

A participant had to search 6 words (2 words for each system) that were randomly chosen from top 500 words from frequently used noun words. The ordering of use of the three systems was balanced. The task was to find similar word pronunciation of a given Japanese word in English language by using a given system. After finding the similar sound of English words, the participants formed a statement by using the phonetically related English and Japanese. Evaluation metrics were task time, NASA-TLX and subjective questionnaires and so on.

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Example: **Task:** Ohayou (Good morning) **Similar word that you select:** Ohio **Generated sen-**

**tence:** You wake up in OHIO state and say GOOD MORNING to your friend.

Simulated work task situation: Imagine that you are a teacher who teaches a Japanese language as L2 to foreign students. You have heard about a mnemonic technique for teaching words of L2. You want to find an English word for each Japanese word that has similar word pronunciation and generate the sentence that can help your student to remember Japanese vocabulary easier.

#### 4. Study Result

All participants answered some questions after using each system. As shown in Figure 4, result from NASA-TLX test shows that the mnemonic-based vocabulary learning system required significantly lower workload than the other two systems to manage mnemonic words. The major reason might be explained by effect of the dynamic words suggestions during a simple interaction in the mnemonic-based vocabulary learning system. From Figure 5 on the result of the relevance score, we confirmed the mnemonic-based vocabulary learning system had higher score than the others. This means that the mnemonic-based system is effective for mnemonic word generation of cross-languages. Post-interviews and other subjective feedback revealed that most participants were satisfied with the mnemonic-based vocabulary learning system. For example, the system was evaluated as the most easily to use and learn, and the most effective, compared to the other two methods. A possible weakness of the mnemonic-based system was about unnecessary continuous motions of the each image when learner is focusing on an image.

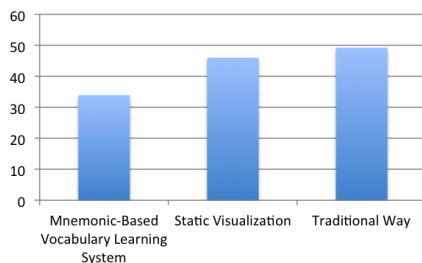


Fig. 4: Result of experiment in NASA Task Load Index (NASA-TLX)

#### 5. Conclusion

In this paper, we proposed a Mnemonic-Based interactive interface, which automatically provides

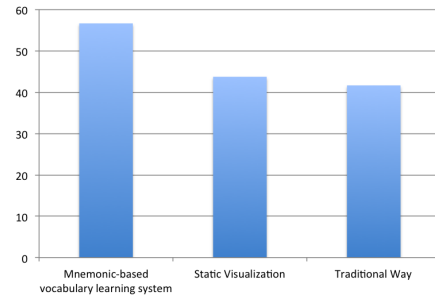


Fig. 5: Result of the Relevance Score

mnemonic word suggestion for second-language vocabulary learning. Additionally, we employed phonetic algorithms for cross-language phonetic comparison. The phonetic algorithms are applied for automatically generating mnemonic materials for vocabulary suggestion. The generated words are interactively and dynamically visualized. A pilot study showed the implemented system outperformed the two traditional systems: manually selection of mnemonic words and static visualization system. For future work, the comprehensive study will be conducted to compare and contrast phonetic algorithms for the purpose of suggesting phonetically relevant words in another language.

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