

Integrating Object Recognition and WordNet for Japanese Thesaurus Acquisition

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Abstract: The primary goal of this research is to develop an innovative approach to Japanese thesaurus acquisition by integrating object recognition technology with the comprehensive lexical database of WordNet. We developed a system in which learners can photograph objects, and the system recognizes and displays Japanese thesaurus for these objects. This approach is hypothesized to improve vocabulary retention by associating words with tangible visuals. The methodology combines technology with language learning, presenting a unique, context-rich educational experience. Preliminary results from learner trials indicate increased engagement and retention compared to conventional methods. This paper outlines this innovative approach, emphasizing the potential of blending technology with traditional educational practices to enhance language learning efficiency.

Keyword: Japanese thesaurus learning, object recognition, learning system, YOLO, WordNet.

1. Introduction

To many foreigners, learning Japanese is not only a pursuit of linguistic proficiency for education but holds a key to unlocking a fuller experience within Japan. However, complicated languages like Japanese takes more effort to reach appropriate fluency. This report presents a study delving into the development of an engaging system to aid learners expanding their Japanese thesaurus through the utilization of visual cues from smartphones. We aim to investigate the potential of using smartphone-captured images of everyday objects to enhance language learning. Next, we explore strategies for integrating thesaurus learning into this framework, enriching learner's vocabulary. Lastly, we compare the effectiveness of this pictorial-based approach against the traditional flashcard methods. Our objective is to assess if this method can improve learning outcomes and offer an efficient way to master Japanese vocabulary, which can benefit lives of international students in Japan ⁽¹⁾.

2. Related Works

Shadiev et al.'s system enhances vocabulary acquisition through an image search of user-taken photographs, demonstrating the value of authentic visual contexts in learning ⁽²⁾. Kikuchi et al. have created W-DIARY, an application that facilitates English vocabulary retention by associating words with personal photographs, leveraging the natural human capacity for visual memory ⁽³⁾.

Lastly, Safitri et al. have employed augmented reality to develop child-friendly tools for learning Japanese vocabulary and hiragana, with their approach showing promise in boosting learning outcomes ⁽⁴⁾.

The originality of our study is the integration of photographic object recognition and WordNet to enhance the acquisition of Japanese thesaurus.

3. Research Design & Methodology

The overview in Figure 1 depicts the PICSU Application process flow, where a user takes a photograph of an object using a smartphone, which is then identified by the YOLO algorithm as a specific word. Subsequently, the WordNet

database is used to find thesaurus for the identified word, aiding the user in learning related vocabulary.

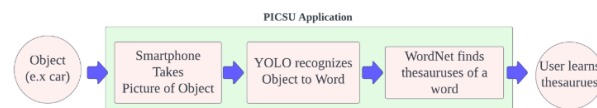


Figure 1. Design of PICSU Application Process Flow

3.1 Proposed Method

Our application boasts an intuitive, user-friendly interface that provides visual references through captured photos, displays the identified word with its common usage in English and Japanese, and offers a list of related thesaurus to enhance vocabulary learning, as shown in Figure 2.



Figure 2. Flow of PICSU System

3.2 System Components

YOLO: YOLO, an acronym for "You Only Look Once ⁽⁵⁾," is a cutting-edge object detection algorithm that our PICSU system employs with its latest version, YOLOv7, to recognize and classify objects in smartphone photos and link them to relevant WordNet thesaurus efficiently and accurately.

WordNet: Japanese WordNet ⁽⁶⁾, created in 2006 by Japan's National Institute of Information and Communications Technology, is a comprehensive vocabulary database. It supports applications by allowing the importation of a library, accessing synsets for Japanese

words (like "車" for car), and providing users with a network of synonyms to enrich their vocabulary.

3.3 System Development

The platform is a web-based mobile application using Python for backend logic and HTML, CSS, and JavaScript for a dynamic front-end user interface, as shown in Figure 3. It utilizes the Django framework for efficient and organized web development, with PostgreSQL as the database for robust data management. It is hosted on HEROKU cloud services for reliable performance and easy deployment.

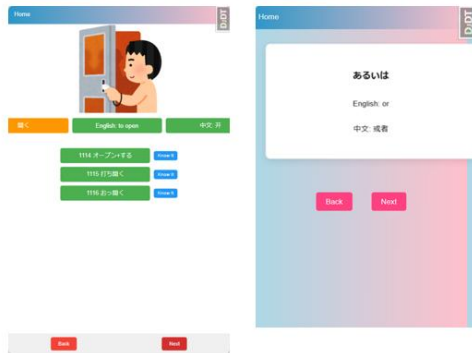


Figure 3. User Interface of PICSU System

4. Experiment

4.1 Overview

The study aims to evaluate the effectiveness of PICSU against conventional flashcards in learning Japanese vocabulary to 20 JAIST international students with varied Japanese language proficiency (JLPT levels N3 or above), consisting of 19 Chinese and 1 Vietnamese students, equally divided by gender, aged between 21 and 30 years old, with an average age of 26.

4.2 Conditions

The process was a two-days study protocol. On the first day, spanning two hours, participants underwent an introductory session, a pre-test to filter out unknown words, followed by alternating learning and recall tests between PICSU and flashcards, with the order of the sessions counter-balanced and breaks included. The first test (FF for flashcards, FP for PICSU) assessed immediate recall post-learning. Two days later, an one-hour delay test (RF for flashcards, RP for PICSU) evaluated retention, using the same content as the first test. The study concluded with a questionnaire, aiming to understand long-term retention and compare the two learning methods.

4.3 Results

Participants' scores are computed by percentage of their correct answers over total correct ones. The statistical analysis of test scores from 20 participants was summarized in Table 1 (blue part). Using the Friedman-Nemenyi Post-hoc Test⁽⁷⁾, scores from four tests (First-test and Retention-test for both Flashcard and PICSU methods) were compared. Significant differences were identified between two specific pairs: (FF, FP) and (RF,

RP) in Table 1 (orange part). Further observation revealed that under our experimental settings, there is no noticeable difference in the memory retention result between PICSU method and Flashcard method. This indicates the PICSU method, in this experiment, might be more effective for enhancing student scores.

Table 1. Friedman-Nemenyi Test Result of Correct Answers by Participants

	FF	RF	FP	RP
Mean	81.813	81.593	90.197	89.610
Standard Error	2.6187	2.7271	2.2947	1.9717
Standard Deviation	11.711	12.196	10.262	8.817
Minimum	60.89	60	56.79	67.9
Maximum	98.33	98.33	99.42	99.44
Count	20	20	20	20
Post-hoc TEST				
Group 1	Group 2	R sum	q-stat	p-value
FF	RF	8	1.385641	0.7610052
FF	FP	24.5	4.243524	0.014467
FF	RP	29.5	5.10955	0.0017567
RF	FP	32.5	5.629165	0.0004121
RF	RP	37.5	6.495191	2.732E-05

5. Conclusion

This study introduced an innovative language learning approach by combining YOLO object recognition technology with the WordNet Japanese language database, demonstrating that a picture-based learning strategy significantly enhances vocabulary acquisition compared to traditional flashcards. Future research will focus on refining the system, exploring long-term retention, and incorporating elements like gamification and auditory components to further enhance learning efficacy and engagement.

References

- (1) マスデン, 眞理子, Mariko, Masden-「留学生の相談から見た日本語学習の必要性」, 熊本大学留学生センター紀要 12 65-70, 2008-12-26
- (2) R. Shadiev, T.-T. Wu, and Y.-M. Huang, "Using image-to-text recognition technology to facilitate vocabulary acquisition in authentic contexts," *ReCALL*, vol. 32, no. 2, pp. 195-212, May 2020, doi: 10.1017/S0958344020000038.
- (3) 菊池開, 長谷川忍: "過去の写真を利用する日記スタイル単語学習アプリケーション W-DIARY の開発", 信学技法, ET2015-61, pp. 15-19, (2015).
- (4) Safitri R, Muslima RT, Herlina S. Mobile Augmented Reality for Japanese Vocabulary and Hiragana Letters Learning with Mnemonic Method. In 2022 Seventh International Conference on Informatics and Computing (ICIC) 2022 Dec 8 (pp. 1-7). IEEE.
- (5) CY Wang, A Bochkovskiy, HYM Liao, 「YOLOv7: Trainable bag-of-freebies sets new state-of-the-art for real-time object detectors」, arXiv preprint arXiv:2207.02696, 2022
- (6) H Isahara, F Bond, K Uchimoto, M Utiyama, K Kanzaki, 「Development of the Japanese WordNet.」, 2008 - cs.brandeis.edu
- (7) Pohlert, T. (2014). The pairwise multiple comparison of mean ranks package (PMCMR). R package, 27(2019), 9.