Doctoral Colloquium—VeRdict: Imbuing VR Language Learning Applications with Dictionary Functionality

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2021 7th International Conference of the Immersive Learning Research Network (iLRN) | 978-1-7348995-2-8/21/$31.00 ©2021 | DOI: 10.23919/ILRN52045.2021.9459345

***Abstract*—As Virtual Reality (VR) hardware becomes increasingly accessible, interest has grown among researchers regarding its use in education. Immersion, however, comes at the expense of multitasking and use of supplementary learning resources like dictionaries. This is a major issue for language learners who have to remove their goggles or switch applications to consult a dictionary. In order to make dictionary use more immersive and convenient for learners, we present in this doctoral colloquium paper, VeRdict, a dictionary extension for VR learning applications that enables dictionary searches from within an application using motion controls. Its client-server architecture allows for the delivery of lexicographic content augmented with 3D object data that can be dynamically added to the virtual world. The dictionary supports manual vocabulary searches using a virtual keyboard, and querying through labels applied to elements within the scene. Additionally, 3D objects loaded from the dictionary can be used as virtual 'props'—unlocking new gesture-based collaborative learning.**

***Index Terms*—virtual reality, dictionary, language learning**

I. Introduction

Virtual Reality (VR) refers to a category of motion-tracked display and controller hardware technologies that create the "illusion of participation in a synthetic [3D] environment" [1]. While rudimentary forms of the technology have existed since the 1960s, the advent of recent consumer-level VR hardware has increased the accessibility of VR [2] and drawn the attention of researchers seeking to unlock its educational potential [3], [4], with applications ranging from history lessons [5] to mathematics [6] and language learning [7], [8].

Different approaches to VR language learning are currently under investigation, with some of the most compelling educational uses of the technology involving VR social platforms that allow language learners from around the world to spontaneously meet and interact with speakers of their target language. Within these virtual contexts, gesturing with motion controllers and interacting with 3D props can provide additional semantic context and help novice learners deduce the meaning of unfamiliar words and phrases [9].

Inevitably, circumstances will arise in which interlocutors cannot negotiate the meaning of a word and wish to consult a dictionary, which is an important tool in the repertoire of any language learner [10], [11]. However, multitasking support for current VR systems being limited, it requires users to either remove their headset mid-conversation or to switch to a separate VR application in order to use a dictionary. This result in interrupting the learning activity and incurring a significant context switch for the user, in addition to severing his connection to others in the case of a group activity.

In this paper, we present VeRdict, a VR software extension that can be integrated into existing VR applications to add dictionary functionality. This ability to perform dictionary searches from within the VR application addresses the need among language learners to access lexicographic information without the distraction of context switching between VR applications or devices.

II. Related Work

Howland et al. [9] present a learning game targeted towards learners of Japanese that features a 3D environment in which objects can be manipulated freely per the user. When the user interacts with an object, its pronunciation and part of speech are displayed with a translation into the player's native language— hence the application's name "Sanjigen Jiten", which translates to "3D Dictionary" in English. The application includes a function for creating vocabulary lists and reviewing them. The software was tested on a group of students who were asked to fill a survey after using the application for retrieving vocabulary from the simulated environment. The overall experience was rated as "good" by most participants. An obvious limitation of the work is that despite its name, the content is more akin to a lexicon: the number of words that can be queried this way is small and limited to the objects placed in the virtual world by the creator of the application. By providing a software component that can be reused in other applications, we allow developers of educational applications to quickly and easily replicate the main functionality presented in [9] without developing it on their own. In addition, since the dictionary content is not embedded into the application, it can be easily updated with more content.

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A randomized experiment regarding the effect of VR applications against a non-VR counterpart (video content) for learning English is presented by [12]. The commercial application used contains 5 scenarios modeled after real-life situations such as riding a train or booking a hotel room. Participants were administered a vocabulary test, along with semi-structured interview and a questionnaire. The results showed that VR users performed significantly better on the vocabulary test than the control group. While most of the learners (83.33% of 49 participants) stated the VR application boosted their motivation, some had reservations about its value as a vocabulary learning tool because the automatic speech recognition (ASR) system performed poorly for them, or because of gaps in their vocabulary. Moreover, ASR systems are built on data from native speakers and often perform poorly with learners. VeRdict solves the issue of speech recognition by proving a way to query the dictionary via a textual interface.

Prior research in neuropsychology has shown that spoken language and gestures are deeply integrated within the human brain [13]. A recent investigation [14] found that pantomiming with 3D props within a VR learning application increased participants' long-term recall of words in a foreign language. In that study, the props and target vocabulary were pre-selected by the researchers. With the server-client architecture of VeRdict that dynamically loads 3D visual representations of target vocabulary, virtual props could be applied to a wider range of educational situations since more objects are available and they are instantiated on user request.

A literature review made on two prominent journals on lexicography, *International Journal of Lexicography* and *Lexikos* as well as the proceedings conferences of EURALEX and eLex with the keywords "VR", "virtual reality" and "*réalité virtuelle*"(both *Lexikos* and EURALEX publish some articles in French) did not yield any results. The work presented here is thus a novelty as far as the field of lexicography is concerned.

III. System Overview

A. Architecture

The project is made of two software components: a reusable VR module providing dictionary services and a dictionary server. The separation between the dictionary VR module and the data (exposed by the server) allows to ship a single VR component, regardless of the language(s) of the dictionary.

The VR component is implemented as a Unity assets package that can be integrated into a VR application. The component allows dictionary lookup to be performed in two ways: (a) performing a manual search by typing keywords through a virtual keyboard interface (see Section III-B), or (b) interacting with 3D objects within the scene that have been assigned a headword tag (Section III-C).

Fig. 1 illustrates the architecture of the project. When a lookup query is sent (1) from a VR client [B], the dictionary server [A] returns (2) the textual data associated with the result of the query. If an entry is associated with a 3D object an additional URL is provided from the client to download it. Not every dictionary entry is accompanied by a 3D model: this is akin to a paper or electronic dictionary for which illustrations, when they exist, are present for a subset of the entries only.

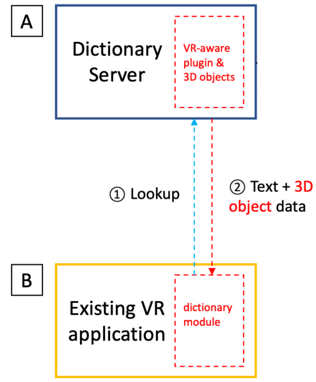

Fig. 1. Project Architecture.

The architecture is modular: in one hand an existing electronic dictionary can be extended to serve 3D models in addition to its current content. On the other hand, an existing VR application can be extended by a library implementing the features described in this paper.

B. 3D Model Instantiation During Word Lookup

Participating in a typical a collaborative VR chat application where a learner is exposed to authentic material would be challenging without the help of a dictionary. To support this use case, the dictionary can be queried directly with text input. VeRdict provides a floating panel where text can be inputted to search for a word, as illustrated by Fig. 2. Text input is done via a virtual keyboard interface. English (qwerty) and Japanese are included, and control is done with virtual laser pointers controller via hand controllers.

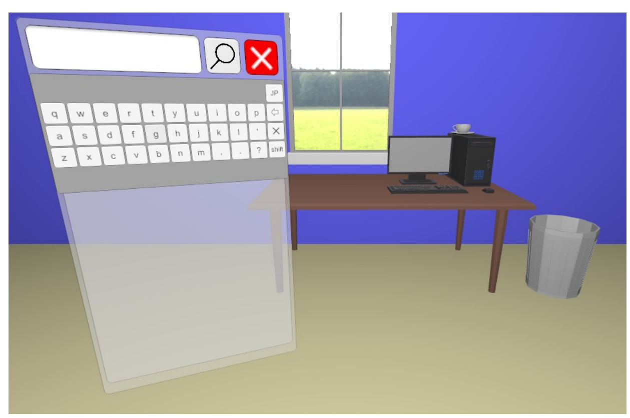

Fig. 2. Dictionary Panel with Virtual Keyboard.

In addition to displaying textual information about the queried word, such as part of speech and definition, our software is able to instantiate in the virtual environment an accompanying 3D model representing the word if one exists. In Fig. 3, the dog was added to the scene after the dictionary lookup has been performed by the user. Once instantiated, the 3D model can then be picked up via motion controls and placed within the virtual scene as an educational prop.

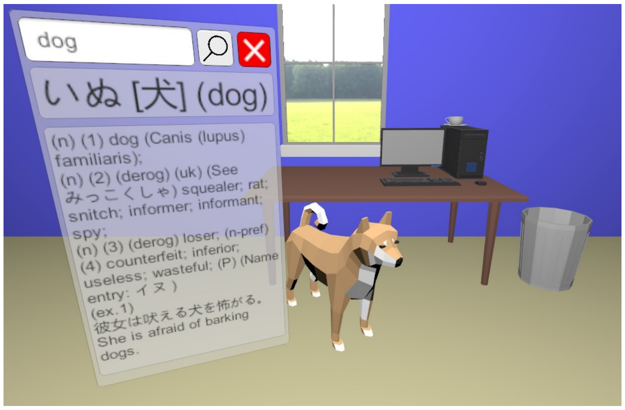

Fig. 3. Dictionary Entry and Associated 3D Object.

In a collaborative application, this consultation mode opens up new communicative possibilities, such as allowing users to explain to each other the specific parts of an object with pointing gestures (e.g. gesturing to the neck of a turkey to explain "wattle"), or explaining the meaning of verbs by picking up a prop and pantomiming the action (e.g. lifting up a rocket prop to explain "lift off").

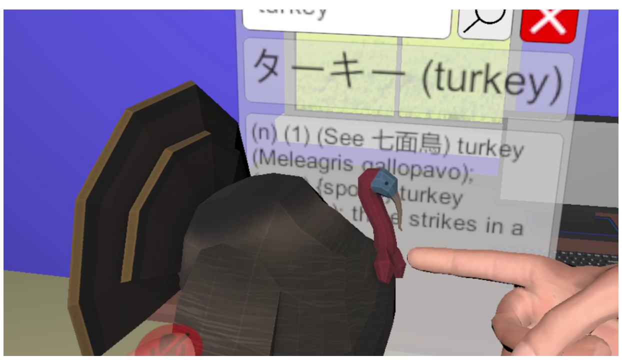

Fig. 4. Explaining Model Details via Hand Gesture.

C. *Query from Tagged Objects*

To use the dictionary feature with this mode, the developers of an application must manually associate each object that is expected to used to perform a dictionary search with a headword. Then, when a given event is triggered in the environment, a dictionary lookup is performed and the lexicographic data are displayed in the dictionary panel.

IV. Discussion and Conclusion

The project is currently in the prototypical stage, albeit already functional. Immediate future work will be gathering feedback about user interface and interactions in a pilot study. Once feedback from the pilot study is integrated, it will be possible to test VeRdict in an experimental setting. In the future, a dedicated application such as a persistent world where a learner could collect and organize objects and their definitions could be implemented. Since the acquisition and curation of the 3D models featured within the dictionary requires manual intervention, it may be advantageous to crowd-source and vet the models via a community submission system.

The educational landscape continues to evolve with the release of new technologies, and the demand for virtual reality applications in education is only likely to grow. Thus, VR researchers and developers should seek to create virtual experiences that provide novel educational experiences without sacrificing the benefits of conventional learning tools. Given the crucial role that dictionaries serve in the language learning process, it is a software feature that ought not be overlooked when developing social and/or language learning applications for VR. In this paper, we presented VeRdict, a software solution that can contribute to this vision by allowing developers to more easily integrate dictionary functionality into their VR apps and experiences.

References

[1] M. A. Gigante, "Virtual reality: definitions, history and applications," in *Virtual reality systems*, R. Earnshaw, M. Gigante, and H. Jones, Eds. Elsevier, 1993, pp. 3–14.

[2] J. Bown, E. White, and A. Boopalan, "Looking for the ultimate display: A brief history of virtual reality," in *Boundaries of self and reality online: Implications of Digitally Constructed Realities*, J. GACKENBACH and J. BOWN, Eds. Elsevier, 2017, pp. 239–259.

[3] M. Fernandez, "Augmented virtual reality: How to improve education systems." *Higher Learning Research Communications*, vol. 7, no. 1, pp. 1–15, 2017.

[4] L. Freina and M. Ott, "A literature review on immersive virtual reality in education: state of the art and perspectives," in *Proceedings of eLearning and Software for Education (eLSE)*, vol. 1, no. 133, 2015, pp. 10–1007.

[5] R. Villena Taranilla, R. Cózar-Gutiérrez, J. A. González-Calero, and I. López Cirugeda, "Strolling through a city of the roman empire: an analysis of the potential of virtual reality to teach history in primary education," *Interactive Learning Environments*, pp. 1–11, 2019.

[6] X. Lei, A. Zhang, B. Wang, and P.-L. P. Rau, "Can virtual reality help children learn mathematics better? the application of vr headset in children's discipline education," in *International Conference on Cross-Cultural Design*. Springer, 2018, pp. 60–69.

[7] A. Lloyd, S. Rogerson, and G. Stead, "Imagining the potential for using virtual reality technologies in language learning," in *Digital language learning and teaching: Research, theory, and practice*, K. M. B. Michael Carrier, Ryan M. Damerow, Ed. Routledge Taylor & Francis, 2017, vol. 222.

[8] V. N. Harris, "Vocabulary learning in VR: How hardware and software interfaces influence word memorization," Master's thesis, Kyoto University, Japan, 2021.

[9] R. Howland, S. Urano, and J. Hoshino, "Sanjigenjiten: computer assisted language learning system within a 3D game environment," in *International Conference on Advances in Computer Entertainment Technology*. Springer, 2012, pp. 262–273.

[10] I. S. P. Nation, *Learning Vocabulary in Another Language*. Cambridge: Cambridge University Press, 2001.

[11] Y. Tono, *Research on dictionary use in the context of foreign language learning: Focus on reading comprehension*. Tübingen: Niemeyer, 2001, vol. Lexicographica : Series maior ; 106.

[12] T.-Y. Tai, H. H.-J. Chen, and G. Todd, "The impact of a virtual reality app on adolescent EFL learners' vocabulary learning," *Computer Assisted Language Learning*, pp. 1–26, 2020.

[13] S. D. Kelly, A. Özyürek, and E. Maris, "Two sides of the same coin: Speech and gesture mutually interact to enhance comprehension," *Psychological Science*, vol. 21, no. 2, pp. 260–267, 2010.

[14] O. Fuhrman, A. Eckerling, N. Friedmann, R. Tarrasch, and G. Raz, "The moving learner: Object manipulation in virtual reality improves vocabulary learning," *Journal of Computer Assisted Learning*, 2020.