Projection-Based AR for Hearing Parent-Deaf Child Communication

Victor Antony[1], Adira Blumenthal[1], Ziyue Qiu[1], Ashely Tenesaca[1], Wanyin Hu[1], Zhen Bai[1]
[1]University of Rochester

***Abstract*— Deaf infants born to hearing parents are at risk of language deprivation due to lack of sign language fluency and subpar parent-child communication. We present a projection-based Augmented Reality (AR) prototype designed to improve parent-child communication and American Sign Language (ASL) acquisition. Our system aims to non-intrusively augment play episodes by projecting just-in-time and context-aware ASL equivalents extracted from nursery rhymes being sung by parents. This paper presents the initial implementation of the prototype .**

***Keywords*—Assistive technology, American Sign Language, Early Language Development, Spatial Augmented Reality.**

Early language deprivation has severe developmental impacts in later life outcomes [1]. Deaf and hard of hearing (DHH) children born to hearing, non-fluent ASL parents are prone to delays, poor educational experiences, diminished career opportunities and psychosocial difficulties [2]. There is a need to improve early childhood language experiences and foster neuropsychological growth in deaf infants by providing a means of early exposure to a visual language. We present a non-intrusive projection-based AR prototype to assist hearing parents to carry out just-in-time and situation-aware ASL during play episodes with their DHH child (see Fig.1).

I. System Description

Our system listens to a user singing a nursery rhyme and determines a set of words for the user to learn based on the user's level of ASL mastery. The system then detects objects corresponding to the rhyme in the projection space. Then, it projects ASL signings of those words near those objects. As the user continues singing, the sets of words change to further ASL learning.

II. System Implementation

The system has two main modules: the Natural Language Processing (NLP) module and the projection-based AR module.

The NLP module conducts live audio transcription and keyword retrieval. First, the system uses the Microsoft Azure speech-to-text service to transcribe the parent's audio sentence by sentence. Then, the system uses dependency analysis based on speech tagging to extract a set of single words and two-word phrases. Lastly, the NLP module will notify the projection-based AR module one ASL word or phrase to be displayed based on different keyword retrieval strategies such as word frequency and grammatical structure complexity (e.g. single word to two-word phrases, common structures). The goal of keyword retrieval is to adapt to an individual's ASL acquisition progress over time. We are currently working with ASL experts to customize the keyword retrieval strategies.

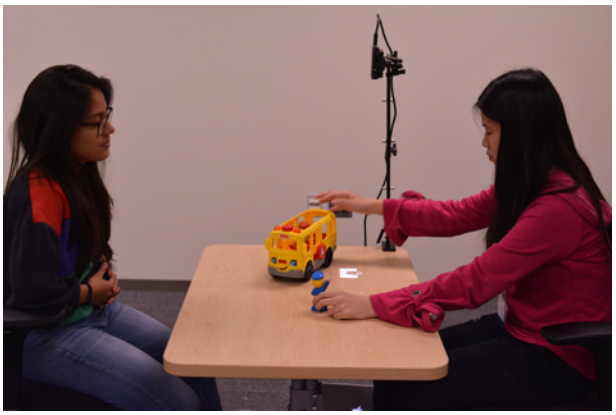

Fig. 1. An illustration of the projection-based AR system

The projection-based AR module is built using the PapARt library [3]. The camera detects fiducial markers corresponding to particular objects and transmits the location and orientation information to the projector display for video projection. The system uses the procamcalib tool [4] to translate between the camera and the projector frame of references.

III. Conclusion

The prototype is currently in the initial stages of development. The next step is to stabilize multimarker tracking and integrate the NLP and AR modules. Once all modules are polished and connected, we will conduct a user study to evaluate the effectiveness of the system in supporting real-time ASL communication between a hearing parent and their DHH child.

IV. References

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