App for naming exercises with automatic feedback for aphasia patients

Eliane Rickert[1], Sandra Wyss[2], Sven Altermatt[3], Markus Degen[4], Sandra Widmer Beierlein[5], Claire Reymond[6], Simone Hemm[7], *Member, IEEE*

Abstract— Prior studies have shown that personalized, tablet-based home practice is effective in the recovery of word finding in aphasia patients. A mobile application was developed which is used as a plugin-platform for the test of different algorithms used in patient feedback and collection of objective parameters (i.e. naming latency (NL)). The application provides direct feedback to the patient and collects training data which the therapist can review and use to adapt the therapy-plan.

Clinical relevance— The study highlights the feasibility of the use of a tablet application with integrated automatic feedback for picture naming exercises for aphasia patients.

I. INTRODUCTION

Speech and language therapy is used to help patients regain their language skills for example after a stroke. In classical therapy sessions, the patient performs different kinds of language exercises such as picture naming under the supervision of a therapist. The success of the therapy can be improved through intensifying the patient exercises and providing direct adequate feedback [1]. During the autonomous training of the patient, objective parameters could be implemented to give feedback to the patient and to support the therapist in designing an optimal therapy. This paper presents an application which can be used as testing platform for feedback by speech recognition and objective parameters, such as NL, based on audio recordings during picture naming.

[1]E. Rickert is with the Institute for Medical Engineering and Medical Informatics, School of Life Sciences, University of Applied Sciences and Arts Northwestern Switzerland, Switzerland eliane.rickert@fhnw.ch

[2]S. Wyss is with the Institute for Medical Engineering and Medical Informatics, School of Life Sciences, University of Applied Sciences and Arts Northwestern Switzerland, Switzerland sandra.wyss@fhnw.ch

[3]S. Altermatt is with the Institute for Medical Engineering and Medical Informatics, School of Life Sciences, University of Applied Sciences and Arts Northwestern Switzerland, Switzerland sven.altermatt@fhnw.ch

[4]M. Degen is with the Institute for Medical Engineering and Medical Informatics, School of Life Sciences, University of Applied Sciences and Arts Northwestern Switzerland, Switzerland markus.degen@fhnw.ch

[5]S. Widmer Beierlein is with the Institute for Special Education and Psychology, School of Education, University of Applied Sciences and Arts Northwestern Switzerland, Switzerland sandra.widmer@fhnw.ch

[6]C. Reymond is with the Institute for Visual Communication, Academy of Art and Design, University of Applied Sciences and Arts Northwestern Switzerland, Switzerland claire.reymond@fhnw.ch

[7]S. Hemm is with the Institute for Medical Engineering and Medical Informatics, School of Life Sciences, University of Applied Sciences and Arts Northwestern Switzerland, Switzerland simone.hemm@fhnw.ch

[8]https://kaldi-asr.org/, Accessed on: Jul. 14, 2021

II. METHODS

The application is developed in a modular setup (Fig. 1) where the user interface is implemented as platform independent web application realized on Android. Algorithms to evaluate the patient's performance are integrated as independent plugins. Two feedback plugins are implemented: for speech recognition a Kaldi[8] Gaussian Mixture Model is trained and a decision algorithm with ternary output (correct, wrong, unsure) is used for the feedback [2]. NL is integrated as C++ library as an extended threshold-based method [3] initially developed in Matlab (Mathworks) with 1477 recordings of 41 German words from 82 healthy subjects. The recorded training data can be transferred to a therapist's computer for further analysis using an SD-Card.
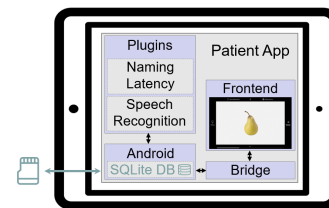

Fig. 1. App framework on a tablet with data exchanged via an SD-Card

III. RESULTS

The presented framework provides naming exercises with feedback in a home-based setup while still allowing therapists to access the training data and thus integrating these exercises in clinical practice. The integrated algorithms achieve the same accuracies on the tablet as previously tested in Matlab with the testset from the healthy subjects.

IV. DISCUSSION & CONCLUSION

The presented work shows the feasibility of the integration of speech recognition and other audio-based feedback algorithms like NL in a picture naming application on a tablet device. So far, the focus was on testing the feedback algorithms individually [2, 3]. Patient usability will be tested in a next step. The modular architecture of the application allows easy extension after insights from user tests or if a new feature combination for the progress tracking is developed.

REFERENCES

[1] K. Bilda (Ed.), "Entwicklung von spezifischen Applikationen für die Sprachtherapie," Neue Technologien in der Sprachtherapie, 1st ed. Stuttgart: Thieme, 2017, ch. 9.

[2] S. Wyss et al., "Patient-friendly speech recognition feedback for aphasia patients," in Conf Proc EMBEC, 2020, p. 283

[3] S. Altermatt et al., "Automatic detection of naming latency from aphasia patients – using an extended threshold-based method," in Conf Proc EMBEC, 2020, p. 71