A Prototype Reading Coach that Listens: Summary of Project LISTEN

Alex Hauptmann, Jack Mostow, Steven F. Roth, Matthew Kane, and Adam Swift

Project LISTEN¹, 215 Cyert Hall, 4910 Forbes Avenue
Carnegie Mellon University Robotics Institute, Pittsburgh, PA 15213-3890

What: Project LISTEN is developing a novel weapon against illiteracy: an automated reading coach that displays a story on a computer screen, listens to a child read it aloud, and helps where needed. The coach provides a combination of reading and listening, in which the child reads wherever possible, and the coach helps wherever necessary. We demonstrated a prototype of this coach at the ARPA Workshop on Human Language Technology in March 1994. A short video shows the coach in action [1].

Who: The intended users of the coach include children in grades 1-3, where oral reading is emphasized. Its developers include experts on speech technology, reading, and human-computer interaction. Its testers include approximately 100 second graders in Pittsburgh public schools who have difficulty in reading.

Why: Illiteracy costs the United States over \$225 billion dollars annually in corporate retraining, lost competitiveness, and industrial accidents [2]. Individuals with low reading proficiency are much likelier to be unemployed, poor, or incarcerated [3]. Automated literacy tutoring is an important, real, and challenging task requiring multimodal interaction and real-time response.

How: Project LISTEN is made possible by years of government-funded research that produced CMU's Sphinx-II speech recognizer [4], which we adapted to detect errors in oral reading of known text [5, 6, 7]. We modelled the coach after expert reading teachers and refined it based on experimental use [8].

Evaluation: Pilot experiments reported in [7] tested both the coach's accuracy in detecting reading errors, and its potential effectiveness in helping children read.

Future work: Our primary goal is to extend and deploy the coach in order to help children read better over time. Possible spinoff applications include adult literacy, English as a second language, foreign language learning, interactive entertainment, and computer-assisted writing. We envision a new generation of intelligent tutoring systems that listen to their students, providing individualized attention that conventional classrooms cannot.

REFERENCES

1. J. Mostow, S. Roth, A. Hauptmann, M. Kane, A. Swift, L. Chase, and B. Weide, "A Reading Coach that Listens (6-minute video)", *Video Track of the Twelfth National Conference on Artificial Intelligence (AAAI94)*, American Association for Artificial Intelligence, Seattle, WA, August 1994.
2. E. Herrick, "Literacy Questions and Answers." Pamphlet, Contact Center, Inc., 1990.
3. National Center for Education Statistics, "Adult Literacy in America", Tech. report GPO 065-000-00588-3, U.S. Department of Education, September 1993.
4. X. D. Huang, F. Alleva, H. W. Hon, M. Y. Hwang, K. F. Lee, and R. Rosenfeld, "The SPHINX-II speech recognition system: An overview", *Computer Speech and Language*, Vol. 7, No. 2, April 1993, pp. 137-148.
5. J. Mostow, A. G. Hauptmann, L. L. Chase, and S. Roth, "Towards a Reading Coach that Listens: Automated Detection of Oral Reading Errors", *Proceedings of the Eleventh National Conference on Artificial Intelligence (AAAI93)*, American Association for Artificial Intelligence, Washington, DC, July 1993, pp. 392-397.
6. A. G. Hauptmann, L. L. Chase, and J. Mostow, "Speech Recognition Applied to Reading Assistance for Children: A Baseline Language Model", *Proceedings of the 3rd European Conference on Speech Communication and Technology (EUROSPEECH93)*, Berlin, September 1993, pp. 2255-2258.
7. J. Mostow, S. Roth, A. G. Hauptmann, and M. Kane, "A Prototype Reading Coach that Listens", *Proceedings of the Twelfth National Conference on Artificial Intelligence (AAAI94)*, American Association for Artificial Intelligence, Seattle, WA, August 1994.
8. J. Mostow, S. Roth, A. Hauptmann, M. Kane, A. Swift, L. Chase, and B. Weide, "Getting Computers to Listen to Children Read: A New Way to Combat Illiteracy (7-minute video)", Overview and research methodology of Project LISTEN as of July 1993.

¹This research was supported primarily by the National Science Foundation under Grant Number MDR-9154059 and by the Advanced Research Projects Agency, DoD, through DARPA Order 5167, monitored by the Air Force Avionics Laboratory under contract N00039-85-C-0163. The views and conclusions contained in this document are those of the authors and should not be interpreted as representing the official policies, either expressed or implied, of the sponsors or of the United States Government.

We thank our principal reading consultant Leslie Thyberg; Raj Reddy and the rest of the CMU Speech Group (Filleno Alleva, Bob Brennan, Lin Chase, Xuedong Huang, Mei-Yuh Hwang, Sunil Issar, Fu-hua Liu, Chenxiang Lu, Pedro Moreno, Ravi Mosur, Yoshiaki Ohshima, Paul Placeway, Roni Rosenfeld, Alex Rudnick, Matt Siegler, Rich Stern, Eric Thayer, Wayne Ward, and Bob Weide) for Sphinx-II; Paige Angstadt, Morgan Hankins, and Cindy Neelan for transcription; Maxine Eskenazi for transcript analysis; Lee Ann Kane for her voice; Jim Kocher for video production; CTB Macmillan/McGraw-Hill for permission to use copyrighted reading materials from George Spache's *Diagnostic Reading Scales*; the students and educators at Colfax Elementary School, East Hills Elementary School, Turner School, and Winchester Thurston School for participating in our experiments; and many friends for their assistance.