NIH COLLABORATION TO IMPROVE AI-READINESS (NOT-OD-21-094) CLOSING OUT MEETING

Detecting Speech Articulation Patterns Following Laryngeal Cancer Treatment Using AI and Machine Learning

(Parent R01: Wearable Silent Speech Processor to facilitate oral communication)

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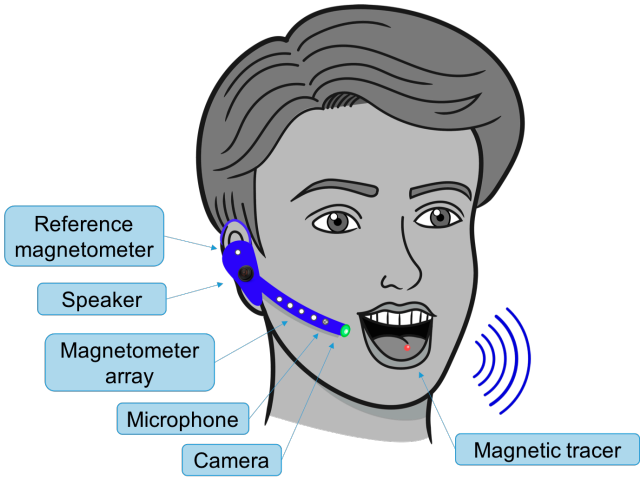
Project Goals

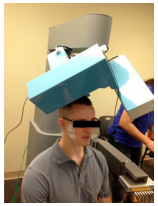
- Wearable silent speech processor to facilitate the oral communication for individuals after laryngectomy (surgical removal of larynx due to the treatment of cancer)
  - Wearable hardware for tongue motion tracking
  - Articulation-to-speech mapping using **AI**, **machine learning**, **automatic speech recognition (ASR)**, and **speech synthesis** techniques
  - Better understand the articulation patterns of alaryngeal speech



Conceptual design

Highlights

- Hardware – wearable device
- Algorithm – up to 90% accuracy
- Articulatory patterns of alaryngeal speech



Commercial EMA
(Carstens, Germany)

Our device: MagTrack

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- Cao, B., Teplansky, K., Sebkhi, N., Bhavsar, A., Inan, O., Samlan, R., Mau, T., & **Wang, J.** (2022). Data augmentation for end-to-end silent speech recognition for laryngectomees, *Proc. Interspeech*, pp. 3653 - 3657.
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- Sebkhi, N., Bhavsar, A., Anderson, D. V., **Wang, J.**, & Inan, O. T. (2021). Inertial measurements for tongue motion tracking based on magnetic localization with orientation compensation, *IEEE Sensors Journal*, 21(6), 7964-7971.
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- Teplansky, K., Wisler, A., Cao, B., Liang, W., Whited, C. W., Mau, T., & Wang, J. (2020). Tongue and lip motion patterns in alaryngeal speech, *Proc. Interspeech*, pp. 4576 - 4580.
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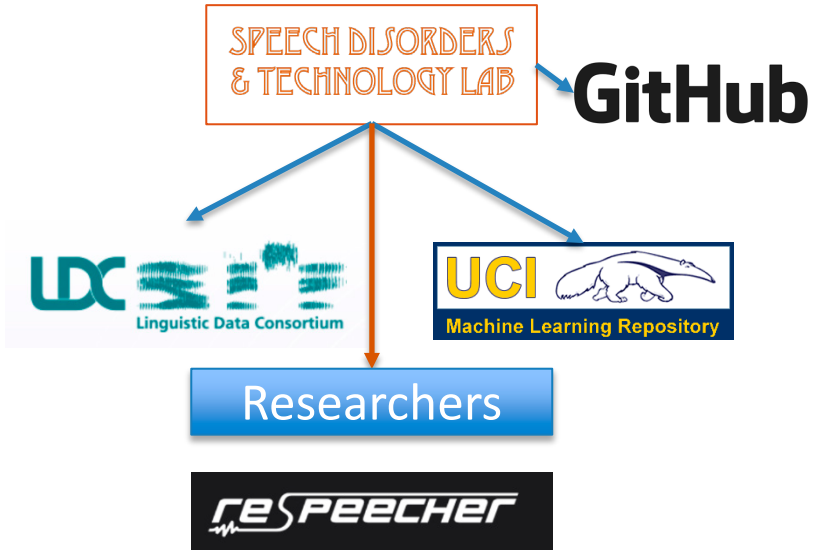
- Cao, B., Sebkhi, N., Mau, T., Inan, O. T., & **Wang, J.** (2019). Permanent magnetic articulograph (PMA) vs electromagnetic articulograph (EMA) in articulation-to-speech synthesis for silent speech interface, *Workshop on Speech and Language Processing for Assistive Technologies* , pp. 17-23.

Highlights – Data Sharing

- Positional (x, y, z coordinates), magnetic, and acoustic data
- Obtained IRB approval for sharing
- Hired a new, external member to check the AI readiness of the data from an outsider perspective
- Data sharing (to public repositories and researchers)
  - Lab website as a portal
  - Github
  - UC Irvine Machine Learning Repository
  - Linguistic Data Consortium (U Penn)
  - Directly to researchers via UT Box (e.g., Respeecher)



Challenges & Future Work

modality.ai

Challenges and Solutions

- Participant recruitment, particularly due to COVID19
  - Solution: remote data collection use a web-based tool (Modality.ai) to collect audio and video (facial movement) data during speech tasks
- PhD student and postdoc recruitment
  - Recruited two postdocs, two PhD students, one research engineer, and a number of undergraduate students so far.
  - No new PhD student in Fall 2022 at UT Austin - Working to hire a new postdoc

Future Work

- Collect more kinematic and acoustic data, as the university is fully open.
- Share to more researchers or communities
- Actively maintain the shared data, code, and documentation

Acknowledgments

Team
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NIH National Institute on Deafness and Other Communication Disorders