



Design of Speech Databases for Diagnosing Neurodegenerative Diseases from Speech

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EWA-DB: Slovak Speech Database for Neurodegenerative Diseases



Objective:

- Early detection of Alzheimer's Disease (AD), Parkinson's Disease (PD), and Mild Cognitive Impairment (MCI) from speech.

Participants:

- Total: 1649 speakers
- 87 with AD, 175 with PD, 62 with MCI, and 1323 healthy controls.
- Diverse age groups (50+ years) and educational levels.

Speech Tasks:

- Sustained vowel phonation, diadochokinesis, object and action naming, and picture description.

Significance:

- Language-specific data for Slovak enables the development of screening tools.



Methodology of Recording

Devices Used:

- Common smartphones (Apple and Android).
- Audio recorded in PCM format (16-bit, 16 kHz, mono).

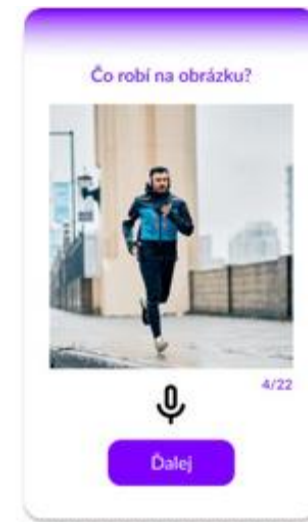
Experimental protocol:

- Anamnestic questionnaire. Basic information about the participant (age, gender, education, lifestyle factors).
- Measures for the inclusion criteria (e.g. MOCA for AD and MDS for Parkinson)



Recorded Tasks

- Sustained vowel phonation: Minimum 6 seconds.
- Diadochokinesis: Repeating /pataka/ for 8 seconds.
- Object and action naming: 60 items (30 objects, 30 actions).





Recorded Tasks

- Picture description: 5 images (3 color, 2 black-and-white), 30-90 seconds each.





Automatic Transcription and Annotation



- Automatic transcription using Automatic Speech Recognizer with adapted LM developed by the Institute of Informatics, Slovak Academy of Sciences.
- Manual Correction by trained annotators corrected transcriptions using Transcriber 1.5.1 software.
- Ensured accurate transcription for machine learning and acoustic model development.
- By manual annotation were marked acoustic events:
- Hesitations ([hez]), non speech sounds ([spk]), interjections (%hm), prolonged sounds (:).
- False starts (+[ned]) and unintelligible words ((x)).
- Tagged phonetic and phonological difficulties.



Data Availability and Access

Database is available through ELDA or Zenodo
<https://zenodo.org/records/10952480>



Publication:

Rusko, M., Sabo, R., Trnka, M. et al. Slovak database of speech affected by neurodegenerative diseases. *Sci Data* **11**, 1320 (2024).

<https://doi.org/10.1038/s41597-024-04171-6>

Name:

- EWA-DB (Early Warning Alzheimer Database).
- ASR transcription is provided for all 1649 speakers.
- For speakers who did not give their consent to publish the recording, only the JSON file is provided.
- Acoustic features were extracted using OpenSmile (GeMAPS settings) and Neurospeech toolkit.
- Usable for machine learning research and clinical studies on neurodegenerative disease detection.



ALOIS Speech Database (under development)



Objective:

- Early detection of Alzheimer's Disease (AD) and Mild Cognitive Impairment (MCI) from speech.

Participants:

- 67 MCI
- 105 healthy controls
- MCI/AD confirmed based on neuropsychological assessment and blood-derived biomarkers
- Extended set of tasks



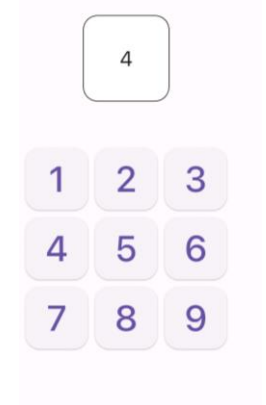
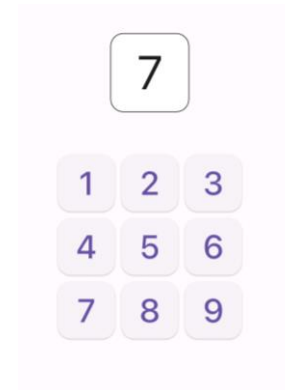
Methodology of Recording

Devices Used:

- Tablet (Apple and Android), min. 10" display.
- Audio recorded in PCM format (16-bit, 48 kHz, mono).

Experimental protocol:

- Allowed offline recording with data uploaded to servers upon internet connection.
- Visual acuity test





ALOIS Speech Tasks

1. Verbal fluency
2. Memory binding test
3. Picture description: Cookie Theft, Christmas
4. Sustained vowel phonation (15 s)
5. Diadochokinesis /pataka/ (15s)
6. Object and action naming (20 & 20 pictures)
7. Procedural discourse
8. Object naming based on a busy picture



ALOIS Speech Tasks

1. Verbal fluency
2. Memory binding test

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Spät

Đalší

Zácvik !

Ktorý z týchto predmetov je

zelenina





<

Spät

Đalší

Ktorý z týchto predmetov je

ovocie



ALOIS Speech Tasks

3. Picture description: Cookie Theft, Christmas





ALOIS Speech Tasks

4. Sustained vowel phonation
5. Diadochokinesis /pataka/
6. Object and action naming (20 & 20 pictures)

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Dalej



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Dalej





ALOIS Speech Tasks

7. Procedural discourse

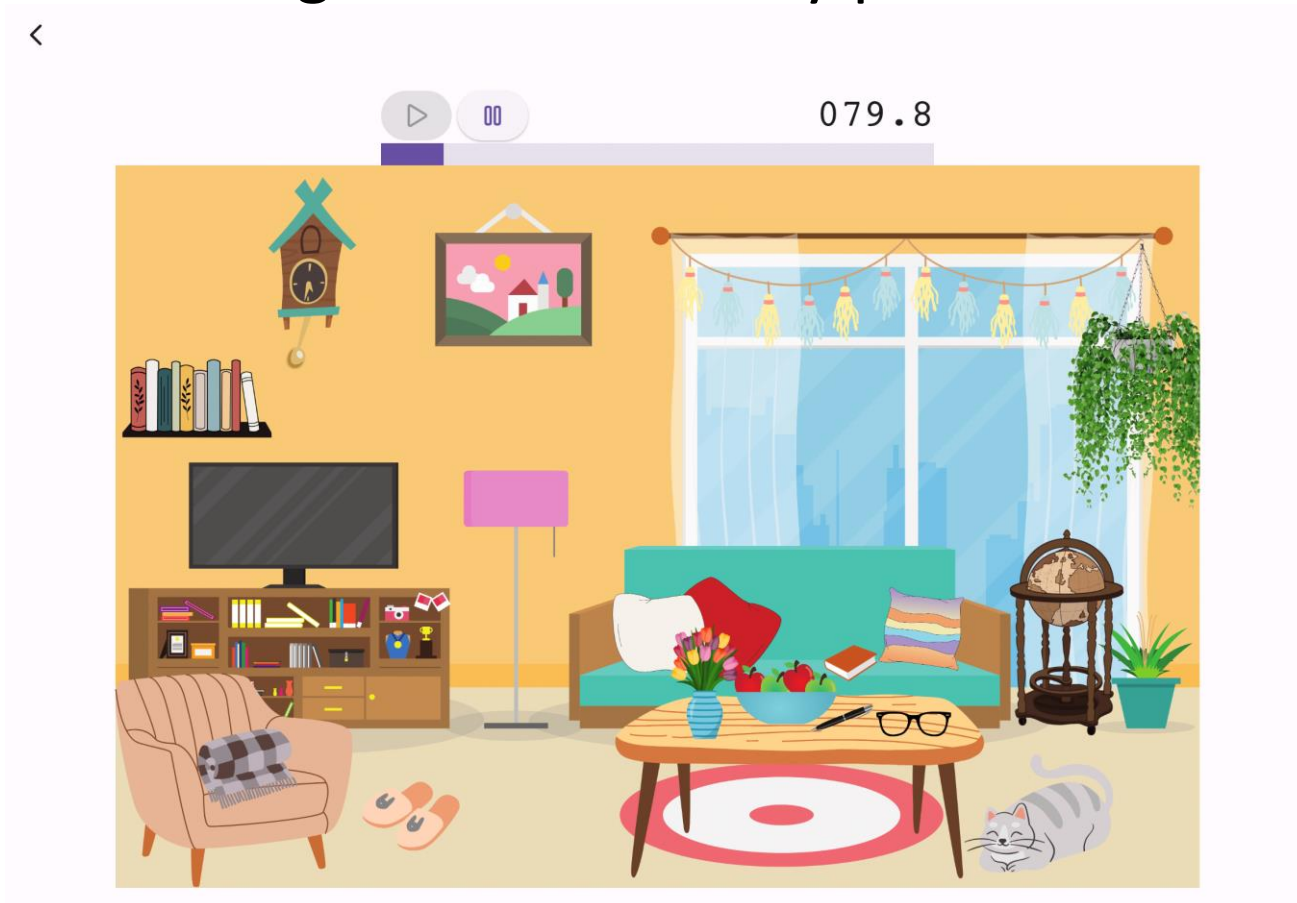
„Describe in as much detail as possible how you prepare tea.“



ALOIS Speech Tasks

8. Object naming based on a busy picture

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Automatic Transcription and Annotation



- Automatic transcription using Automatic Speech Recognizer with adapted LM developed by the Institute of Informatics, Slovak Academy of Sciences.
- Extended: automatic speaker detection
- Manual Correction by trained annotators.
- Extended: speaker turn and parallel speech annotation set of labels



Speech Database Development Experience



- Room acoustics, external noise, investigator's sounds (writing, mhm)
- Task difficulty (not all tasks suitable for the norm are appropriate for MCI and AD)
- Application control by the experimenter
- Refinement of diagnostics, MoCA only is not sufficient
- Screen size: tablet vs. smartphone
- Visual acuity test
- Informed consent for recording publication (not just the transcription)
- Updating software of recording devices
- Selection of suitable libraries for sound recording



Thank you for your attention!

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