Enhancing Dementia Screening in Ageing Deaf Signers of British Sign Language via Analysis of Hand Movement Trajectories

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Project Objectives


- Deaf population receives unequal access to diagnosis and care for acquired neurological impairments, due to unavailability of health staff with appropriate language skills.
  - Resulting in poorer outcomes
  - Increased care costs

- Aims to improve early screening for dementia among ageing signers of BSL
  - thus assisting clinicians who have limited knowledge about BSL in diagnosing dementia in deaf people
WHAT IS BSL?

♦ Sign languages are natural human languages, created by Deaf communities, and unrelated to spoken languages. They make use of
  – Hand actions
  – Face, head, and mouth movements
  – Body movements

Figure 1: Sign Space in front of a Signer’s Body

BSL Corpus Conversation: https://bslcorpusproject.org/
STAGES APPROACHED

♦ Stage 0: Literature on sign language, different possible feature extraction methods such as depth map model.

♦ Stage 1: Data Gathering- 4 BSL Data Sources
  – BSL Corpus of 60 signers aged over 50
  – BSL Cognitive Screen norming data of 250 signers aged between 50-80
  – Case studies of signers with early stage dementia.
  – Standard 2D videos on the BSL Signbank

Stage 3

Figure 2: Project Procedures
Stage 2a: Provide a technological foundation using machine learning approaches to identify differences in the sign space envelope and facial expressions of signers as a key to identifying language changes associated with dementia

- sign space envelope: sign trajectories/depth/speed
- facial expressions of deaf individuals

Figure 3: Signbank dataset and trajectory tracking
Software Development


♦ Methodology:
  – based on CRoss-Industry Standard Process for Data Mining Standard
  – Software Engineering approach is being Agile

♦ Achievement: real-time two hands trajectory tracking

♦ Further Experimentation: more open source libraries/deep learning

♦ Research Outcomes:
  – [https://www.screeningdementiabsl.uk/]
  – Code and datasets of the project will be released under an open source licensing model. [https://github.com/XingLiangLondon]
  – Software Toolkit deployed will be well documented for re-usability and sharing among peers, researchers and developers.
Software Implementation (1)

- Hand movement trajectory tracking developed in Python 3.6.5 and OpenCV 3.3.1 environment.

Figure 5: Hand Trajectory Tracking Demo
Figure 6: Hand Tracking Algorithms
Figure 7: 3D Hand Tracking Trajectory

Figure 8: 2D Hand Tracking Trajectory
Stage 2b: Machine Learning algorithms
- Deep Neural Network Models will be used for the incremental improvement of dementia recognition rates based on the differences in patterns from facial and trajectories motion data.
- Convolutional Neural Network/Recurrent Neural Network/Hybrid
- Train/Validate the results with cognitive screening results

Stage 3: Pilot-evaluation
- As necessary, participants will be recruited in collaboration with Deaf organisations such as Sign Health and Sonus for the evaluation of the Automated Screening Toolkit.
CONCLUSIONS

♦ A computer vision and deep learning based automated screening toolkit will support screening for dementia in deaf signers of BSL.

♦ Unlike other current computer vision systems used in dementia stage assessment (RGB-D video or monitoring using ICT facilities), the proposed system focuses on analysing the sign space envelope and facial expressions of deaf individuals using standard 2D videos.
  – Potential for economic, simple, flexible, and adaptable assessment of other acquired neurological impairments associated with motor changes, such as stroke and Parkinson’s disease in both hearing and deaf people.
Questions?

https://www.screeningdementiabsl.uk/