Overview

Goal:
- SL education tool development for SL production self-assessment and objective evaluation.
- SL recognition (SLR) from videos in a signer-independent (SI) mode under realistic recording conditions.

Previous work (1, 2, 3):
- A suitable platform for the SL-Redu project is built involving “passive”-type GSL learning exercises.

Contributions:
- Focus on isolated signs and continuously fingerspelled letter sequences.

First education tool in SLG with recognition functionality.

Evaluation:
- High multi-signer (MS) and SI recognition accuracies.
- Evaluation by student and expert users of the SL-Redu platform and its recognition functionality demonstrates very satisfactory objective and subjective assessments.

SL-Redu Platform

- Enables self-monitoring and objective learner evaluation.
- System’s design involves all aspects of GSL linguistics:
  - Teaching techniques and content, including various SL practice assignments.
  - Multiple-choice questions: images, videos, and text.
  - User response or user feedback by means of video recordings of GSL production.
- Enables the user to actively sign and be assessed for the capacity to appropriately generate signs.
- SL-Redu prototype system:
  - Web-based application managing the end user’s interaction.
  - System modules entail the system database, the front-end and back-end user interfaces, and image/video files.
  - SLR is a separate system module running as standalone on the learner’s device.

Experimental Framework

Multi-signer (MS) recognition:
- Training 80% of all videos (numerals: 1,440; non-numerals: 3,436; fingerspelling: 857).
- Validation 10% of all videos (numerals: 180; non-numerals: 432; fingerspelling: 107).
- Testing 10% of all videos (numerals: 180; non-numerals: 432; fingerspelling: 107).

Signer-independent (SI) recognition:
- 20-fold cross-validation for numerals.
- 24-folds cross-validation for non-numerals.
- 12-folds cross-validation for fingerspelling.
- Each fold contains one test subject, all remaining subjects are used in training.

SL-Redu platform user evaluation:
- Training: 90% of the available videos (numerals: 1,620; non-numerals: 3,888; fingerspelling: 964).
- Validation: 10% of the available videos (numerals: 180; non-numerals: 432; fingerspelling: 107).

GSL recognition performance:
- Isolated GSL and continuous fingerspelling tasks under both MS and SI training/testing cases.
- GSL recognizer objective evaluation results.
- Results in word accuracy (WAcc) %, and in the case of fingerspelling in letter accuracy (LAcc) %.
- Isolated GSL recognition task:
  - Performance degrades in SI case.
  - WAcc unsatisfactory in both isolated SLR tasks.
- Objective evaluation: results better than SI scenario.
- Continuous fingerspelling recognition task:
  - Performance suffers at the WAcc level, especially for longer letter sequences.
  - Higher LAcc results.
- Objective evaluation: results better than SI scenario.

Conclusions

- Presented the SL-Redu learning platform GSL recognizer:
  - Isolated signs and continuously fingerspelled sequences.
- Recognition module:
  - Incorporates state-of-the-art deep learning based visual detection, feature extraction, and classification.
  - Operates in a SI fashion in non-ideal visual environments.
- Designed module performs very well, as evidenced by experimental results.
- Yields very satisfactory objective and subjective user evaluation of the SL-Redu platform.

References