Development of Low Resource Machine Learning Models for Child Cognitive Ability Assessments

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Abstract

Automated cognitive assessment tools are state- of-the-art in assessing cognition development. Due to the low availability of resources, building automated cognitive ability evaluation tool is a challenging task. This study mainly focuses on developing machine learning models using a limited amount of data to assess Reasoning IQ, Knowledge IQ, Mental Chronometry and Attention-levels of Sinhala-speaking children between the ages of 7 to 9 years. Our solution includes Sinhala speech recognition systems, image classification models, gaze estimation, blink count detection and facial expression recognition models to evaluate the above four cognitive ability measuring factors. Open domain speech recognition has been used to evaluate complex Sinhala child verbal responses and limited vocabulary responses were assessed using an end-to-end speech recognition system, respectively achieving 40.1% WER and 97.14% accuracy. Additionally, the image classification models for handwritten Sinhala two shape recognition models have gained 97%, 89% and 99% accuracies. The linear regression model for attention level evaluation that utilizes the inputs from a combination of eye-gaze estimation, facial expression recognition and blink rate detection models have gained 85% accuracy.

Keywords

Cognitive Evaluation, Kaldi, CNN, Transfer Learning, Sinhala Speech Recognition, Sinhala Written Letter Recognition, Attention-Span Evaluation