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Project Proposal: Educational Game Using Sign Language Detection With A CNN

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1. The Problem

Millions of deaf people use sign-language to communicate **(Huenerfauth, M. & Hanson, V.L.)**, those without impaired hearing know very little of sign language. We wish to provide a computer platform to teach ASL. By developing an educational game which bases the users' score on the number of signs they correctly match with an on-screen prompt, we hope to create entertaining but effective education for those new to ASL. The problem has real-world use and benefits the deaf community, giving further options for ASL education.

2. Context and Background

"For spoken languages, a computer system can display written text onto the screen for the user. For sign languages, this approach is generally not possible" **(Huenerfauth, M. & Hanson, V.L.)**, this shows the demand for converting sign language into computer input, the idea for us to use this for education stems from the popularity and effectiveness of the app Duolingo. **Mayer, R.E. (2018)** states there are "three promising areas" where games may be "more effective than conventional media", included in this is "second-language learning". Our research concluded an educational game following in the footsteps of Duolingo could have great use in helping the teaching of ASL.

3. The Dataset

The dataset used to train our model will be a collection of labelled images containing various hand gestures representing the ASL. We will gather this data ourselves, ensuring our dataset incorporates a varied range of images containing different backgrounds and individuals making the gestures. This method gives us greater control over the format of the images and the words the model will learn to recognize. We will gather the images using a webcam with all members of the group performing the hand gestures which we can then manually label.

4. Methodology

We plan to use CNN to detect words in sign language, we will utilize existing CNN implementations for ASL detection as a reference, and open-source libraries like TensorFlow & Keras for the development stage. Our reasoning was that "CNNs are effective tools for image understanding" **(Sarvamangala & Kulkarni, 2021, p.1)**. To improve the model's accuracy, we will undertake parameter optimization (kernel sizes, training techniques). We plan to implement real-time webcam tracking using OpenCV to detect a hand for an interactive educational experience. Our approach to the problem will reflect a trial-and-error process.

5. Evaluation

To evaluate how well CNN detects sign-language we'll use confusion matrices, heatmaps & accuracy plots to represent the efficiency of the model. Quantitative analysis of the model will be applied through F1 score, precision & recall. This will serve as a comparison of the model to similar projects that have already been completed as well as fine tuning hyperparameters to optimize the model's performance.

REFERENCES

Huenerfauth, M. and Hanson, V.L. (2009) Sign Language in the Interface: Access for Deaf Signers. *The Universal Access Handbook* [online]. pp. 1-18 [Accessed 10 March 2023]

Mayer, R.E. (2018) Computer Games in Education. *Annual Review of Psychology* [online]. 70, pp. 531-549. [Accessed 10 March 2023]

Sarvamangala, D.R. and Kulkarni, R.V. (2021) Convolutional neural networks in medical image understanding: A survey [online] *Evolutionary Intelligence*, 15(1), pp. 1–22. [Accessed 17 March 2023].