

# Human-Computer interaction based on real-time EOG signal classification

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**Abstract**—In this paper, we propose an HCI system based on EOG signals, which includes designing experiments using OpenBCI to collect EOG signals from multiple directions of the user and the corresponding visual direction categories, constructing and training an EOG-visual direction classification model. According to the control strategy corresponding to the line-of-sight direction category, the user could control the HCI device.

**Clinical relevance** — This system can reduce the software and hardware costs of HCI while achieving a simple and effective interaction method. It also creates the possibility for patients with neurodegenerative diseases to control the computer.

## I. INTRODUCTION

EOG are one of the easiest ways to estimate eye movements with low-cost devices. In this work, we propose a new efficient EOG-based HCI system.

## II. METHODS

### A. Differential EOG Acquisition

The system uses an OpenBCI Cyton acquisition board with a sampling frequency of 250 Hz to acquire the EOG signal.

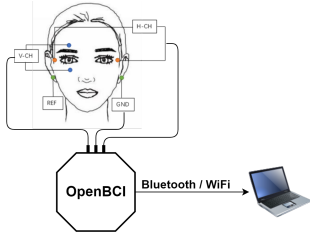


Fig. 1. EOG acquisition

As shown in Figure 1, the electrodes for collecting horizontal EOG are fixed on both sides of the face. The electrodes for acquiring vertical EOG are fixed above and below the center of the left or right eye. The reference electrode and ground electrode are fixed at the user's mastoid.

### B. Classification Model

The classification model uses EOG as the training data and the real sight direction as the label. Considering that the HCI system needs to ensure real-time, we design an efficient classification model.

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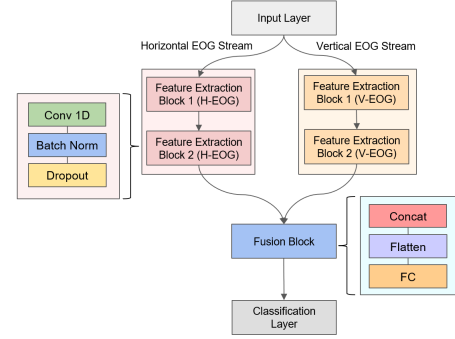


Fig. 2. EOG Model

The structure of the model is shown in Figure 2. Firstly, the horizontal EOG features and vertical EOG features are extracted respectively; Secondly, feature fusion is performed. Finally, the classification results are derived as the control commands.

## III. RESULTS

The source code of our models is implemented using Keras, which will be released at a Github repository<sup>1</sup> as for reproducibility.

TABLE I  
EOG-HCI Evaluation Metrics

|                  | Precision | Recall | F1-score |
|------------------|-----------|--------|----------|
| looking-straight | 1.00      | 1.00   | 1.00     |
| looking right    | 1.00      | 0.75   | 0.86     |
| looking-left     | 0.75      | 1.00   | 0.86     |
| looking-up       | 1.00      | 1.00   | 1.00     |
| looking-down     | 0.83      | 0.83   | 0.83     |
| Total            | 0.92      | 0.92   | 0.91     |

## IV. DISCUSSION & CONCLUSION

The HCI system proposed in this paper is simple to operate, with low hardware cost and high generalization capability.

## References

- [1] Kumar R. Identifying Eye Movements using Neural Networks for Human Computer Interaction[J]. International Journal of Computer Applications, 2014, 105(8):9.

<sup>1</sup><https://github.com/chenhuiyu/OpenBCI-EOG-Movement>