Identifying eye movements in pediatric electroencephalogram (EEG): A machine learning approach

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Introduction

- The application of independent component analysis (ICA)to electroencephalogram (EEG) data has greatly improved the ability to detect and isolate artifacts such as eye blinks and saccades.
- However, current algorithms for classifying these artifacts may be time-consuming, especially for noisier data, such as pediatric data

Aim:

- Develop a web application that integrates supervised machine learning to automatically classify eye artifacts in pediatric EEG data.

Methods: Participants

•EEG data were acquired from children (N = 56; ages 5-6.5 years Mean = 5.63, *SD* = .44)

•Children participated in an auditory-selective attention task in lab and school settings

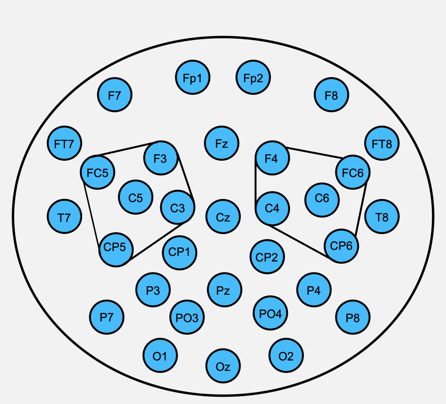

Figure 1: 32 Biosemi electrode cap

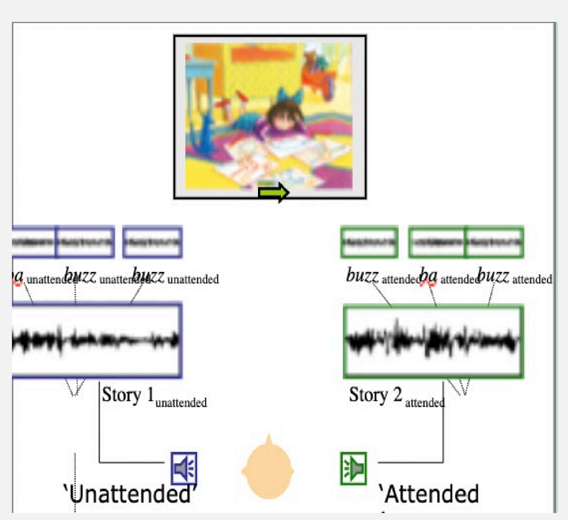

Figure 2: Dichotic listening task

Method: Machine Learning

- Following the visual classification of eye components by expert raters, we utilized IBM Cloud Annotation to label each ICA component and put each class folder into the image detection framework using Teachable Machine (a web platform for creating supervised machine learning models).
- We trained our images under three classes: Saccade, Blink, Not an Eye.
- The algorithm was then applied to pediatric EEG data.
- Visual Studio Code, HTML, CSS, and JavaScript were used to import the model into the web application.
- Based on the provided ICA component, the application calculates a confidence score between 0 and 1. The confidence score is a way to measure how confident the algorithm is for each of the three components (blink, saccade, and not an eye).

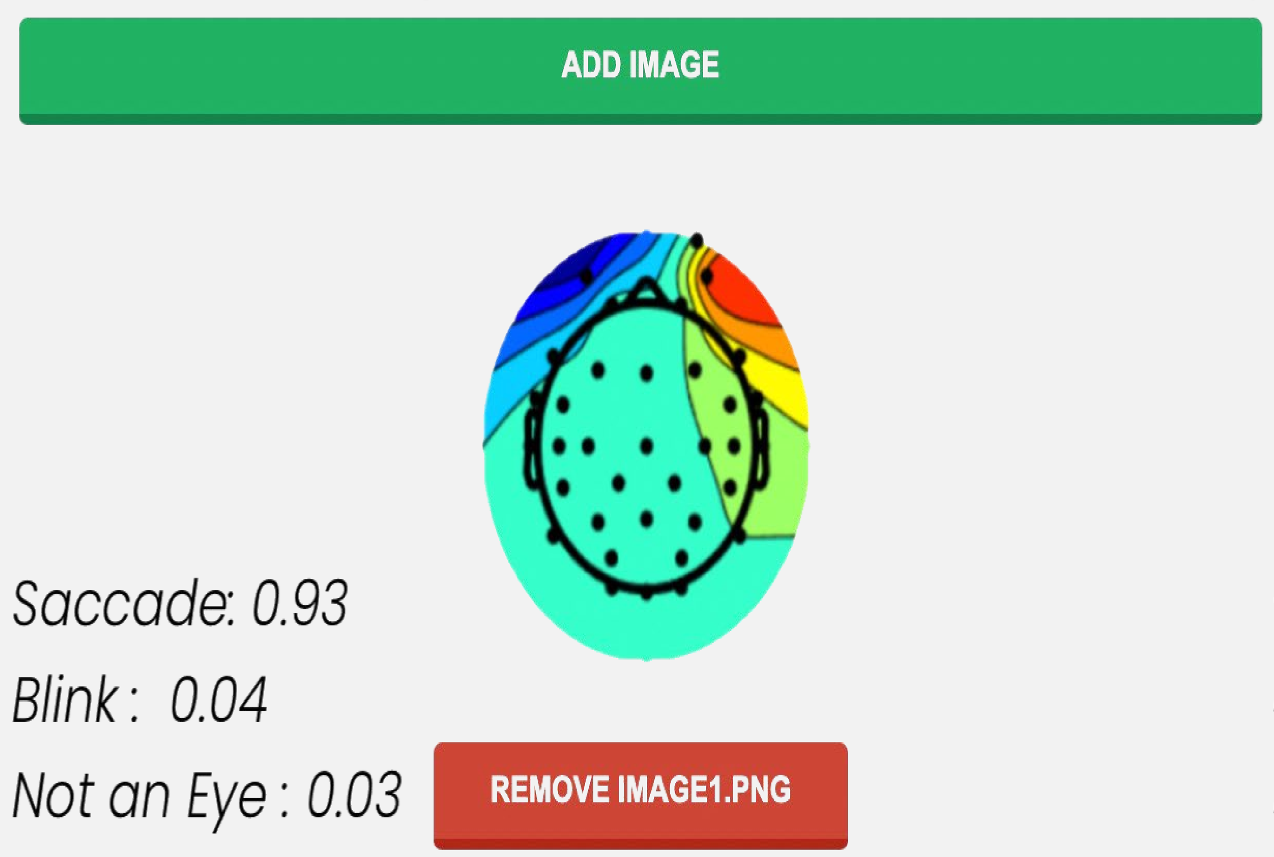

Figure 3: ICLabel with a saccade

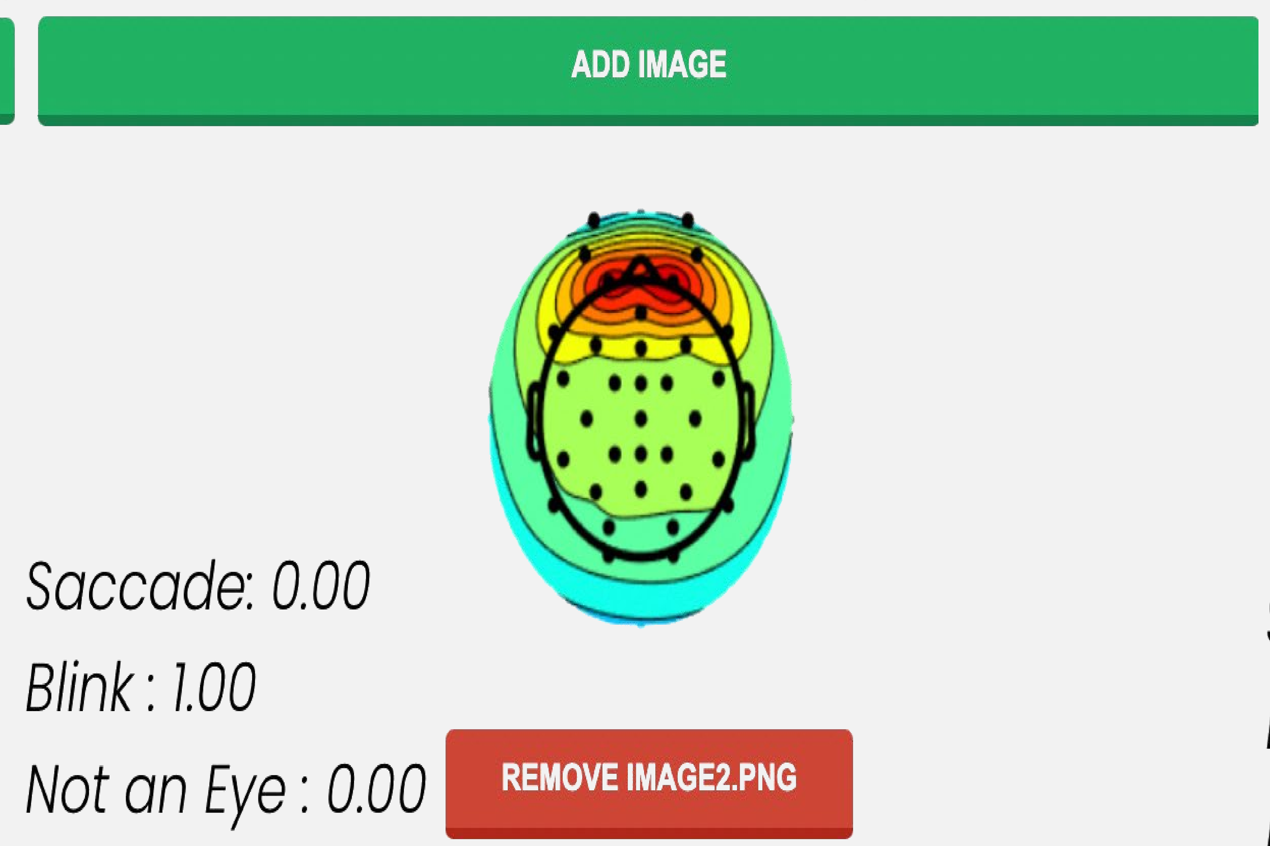

Figure 4: ICLabel with a blink

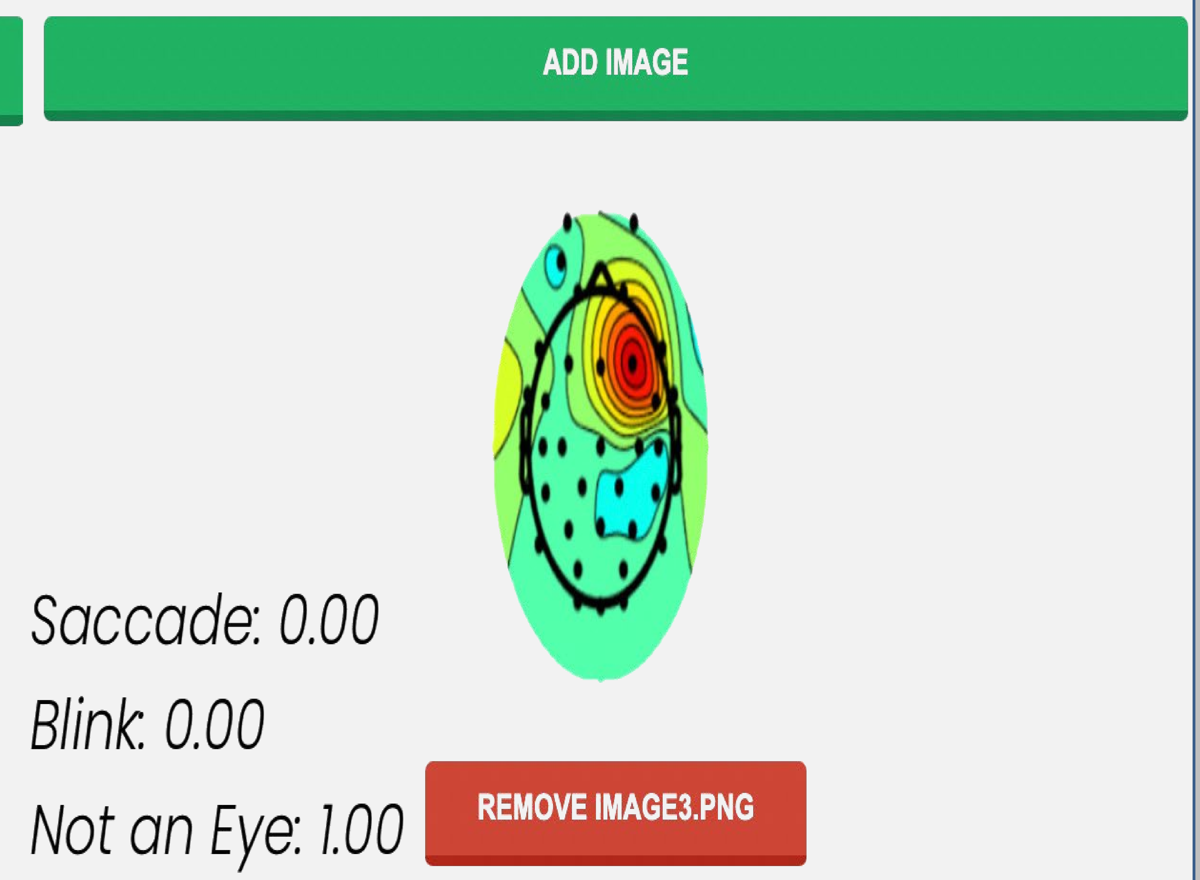

Figure 5: ICLabel without an eye component

Results

- With an epoch of 80 cycles (cycling through the entire training dataset 80 times), a batch size of 16 (number of samples each iteration was trained on), and a 0.001 learning rate (the amount the weights were updated during training), we achieved the highest accuracy rate per class (0.009874) and the lowest minimized loss (0.001007).

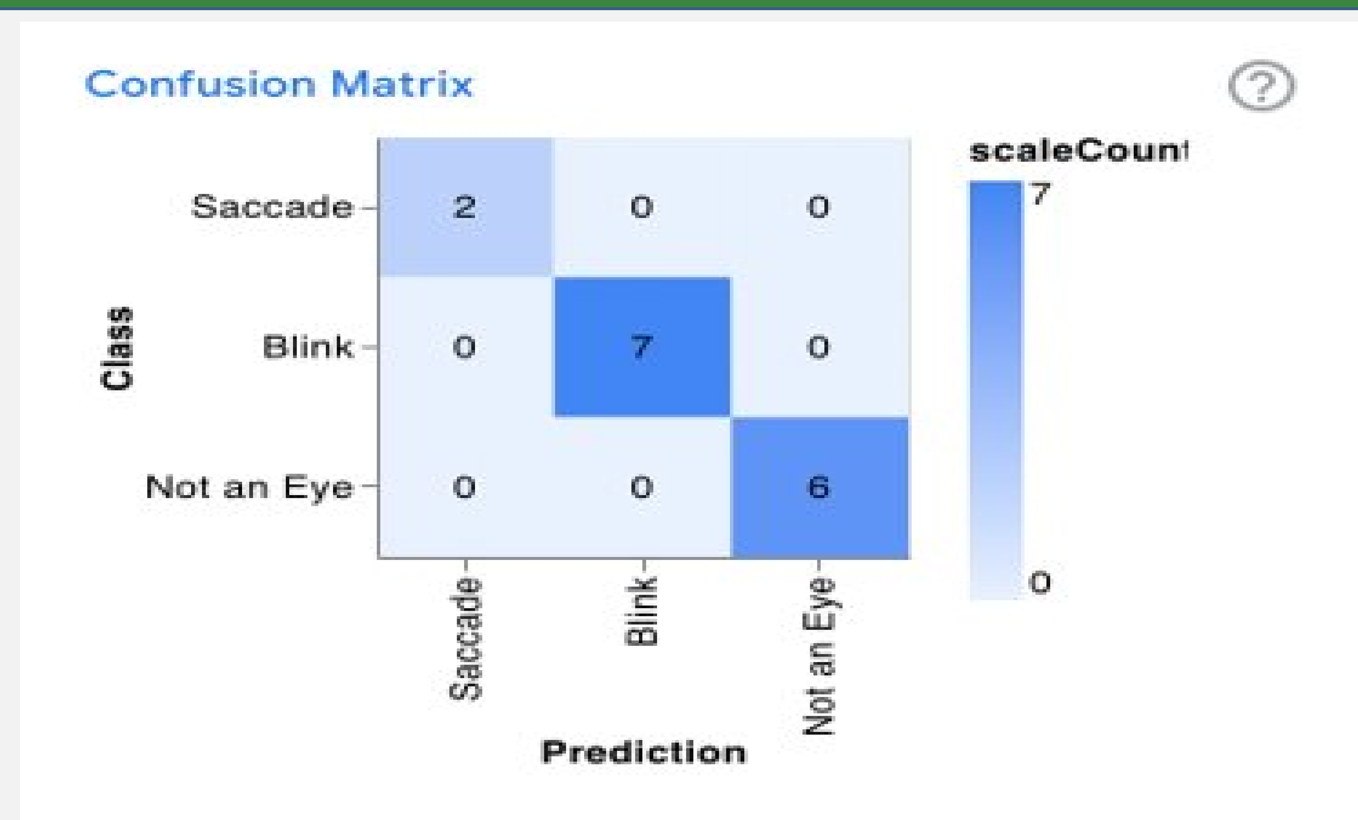

Figure 6: Confusion Matrix

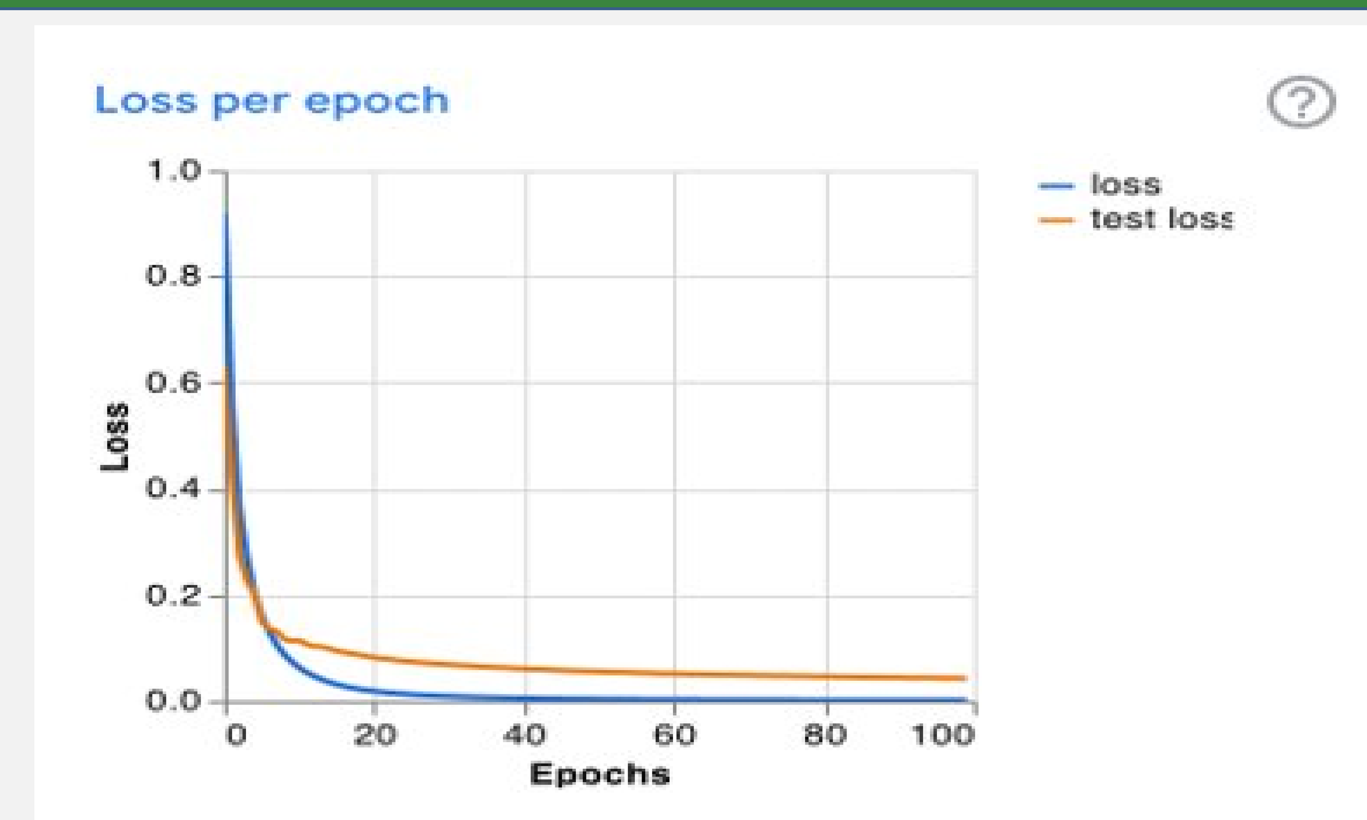

Figure 7: Loss per epoch

Discussion

- Visually identifying eye blinks and saccades requires intensive training and is time-consuming.
- The supervised machine learning algorithm we used was time-efficient and easy to use.
- This approach can reduce EEG data processing time and be used to automatize artifact detection in pediatric EEG data.
- Future research will focus on developing algorithms to classify other artifacts and applications with diverse populations.

References

1) Delorme, A., Sejnowski, T., & Makeig, S. (2007). Enhanced detection of artifacts in EEG data using higher-order statistics and independent component analysis. Neuroimage, 34(4), 1443-1449.

2) Coch, D., Sanders, L. D., & Neville, H. J. (2005). An event-related potential study of selective auditory attention in children and adults. Journal of cognitive neuroscience, 17(4), 605-622.

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