A Machine Learning based Eye Tracking Framework to detect Zoom Fatigue

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What is ZOOM Fatigue?

- Zoom fatigue is an issue faced by individual due to increase video conferencing
- Zoom fatigue is not limited to video calls or video conferencing, it can be any interactive social event such as online schooling, lecture, activity
- The brain has tendency to exhaust faster with online communication due to absence of body language such as gesture and emotions

Why is it important to identify Zoom Fatigue ?

- Zoom fatigue is grew rapidly globally with increase in online communication due to restrictions and social distancing due to COVID19
- Virtual interactions can be extremely hard on the brains that leads to early exhaustion
- By analyzing the features of online which may cause the zoom fatigue, prevent its effects
- It's even possible Zoom fatigue will abate once people learn to navigate the mental tangle video chatting can cause.

Research Question

To what extent can the features from the eye tracker be used to detect zoom fatigue?

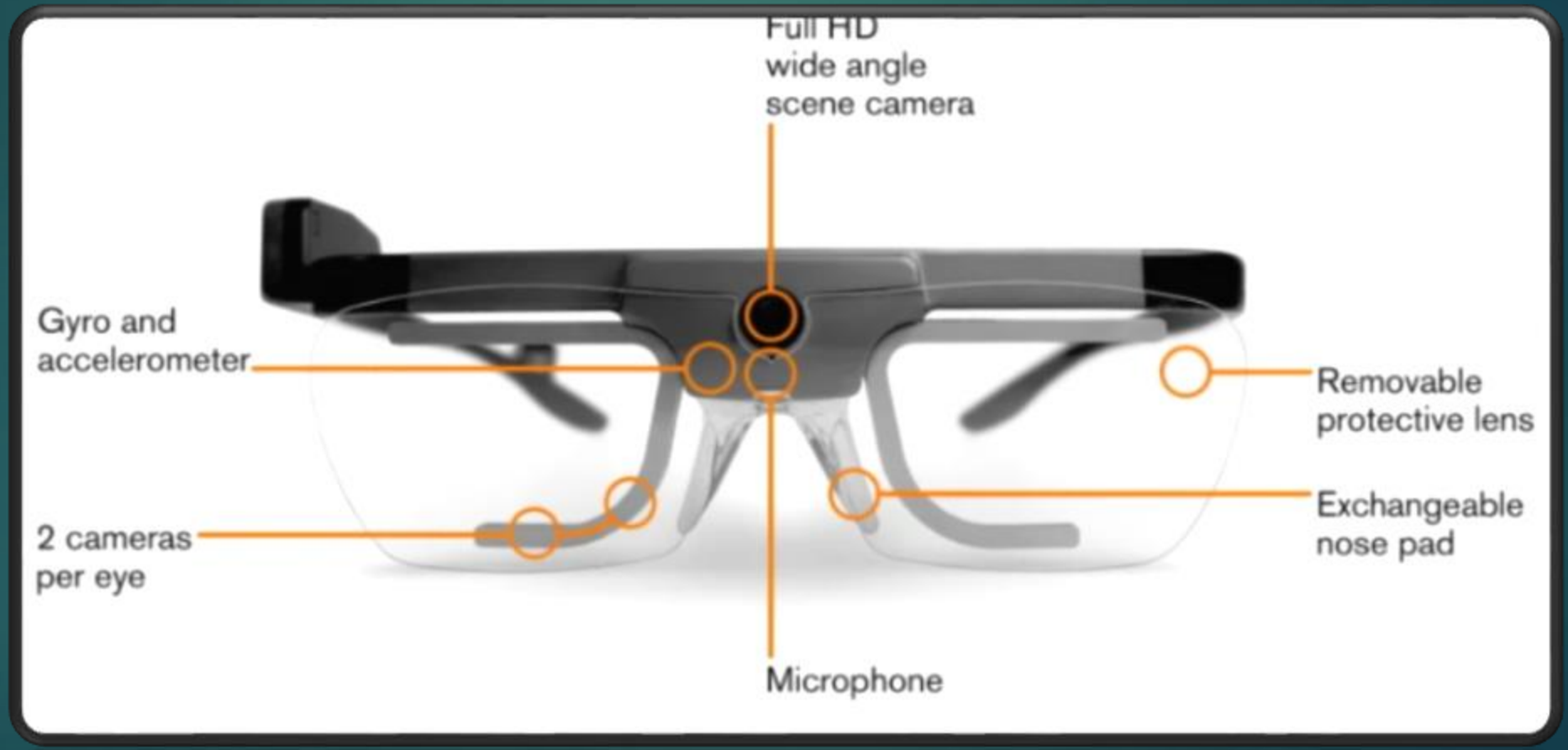
Introduction

- The research proposes a machine learning based eye tracking framework (MLETF) and the extent to which machine learning can detect zoom fatigue using the output of an eye tracking device
- The proposed MLETF in this research helps to determine the feature which affects the zoom fatigue
- Understanding these features can help us prevent growth of zoom fatigue in individuals

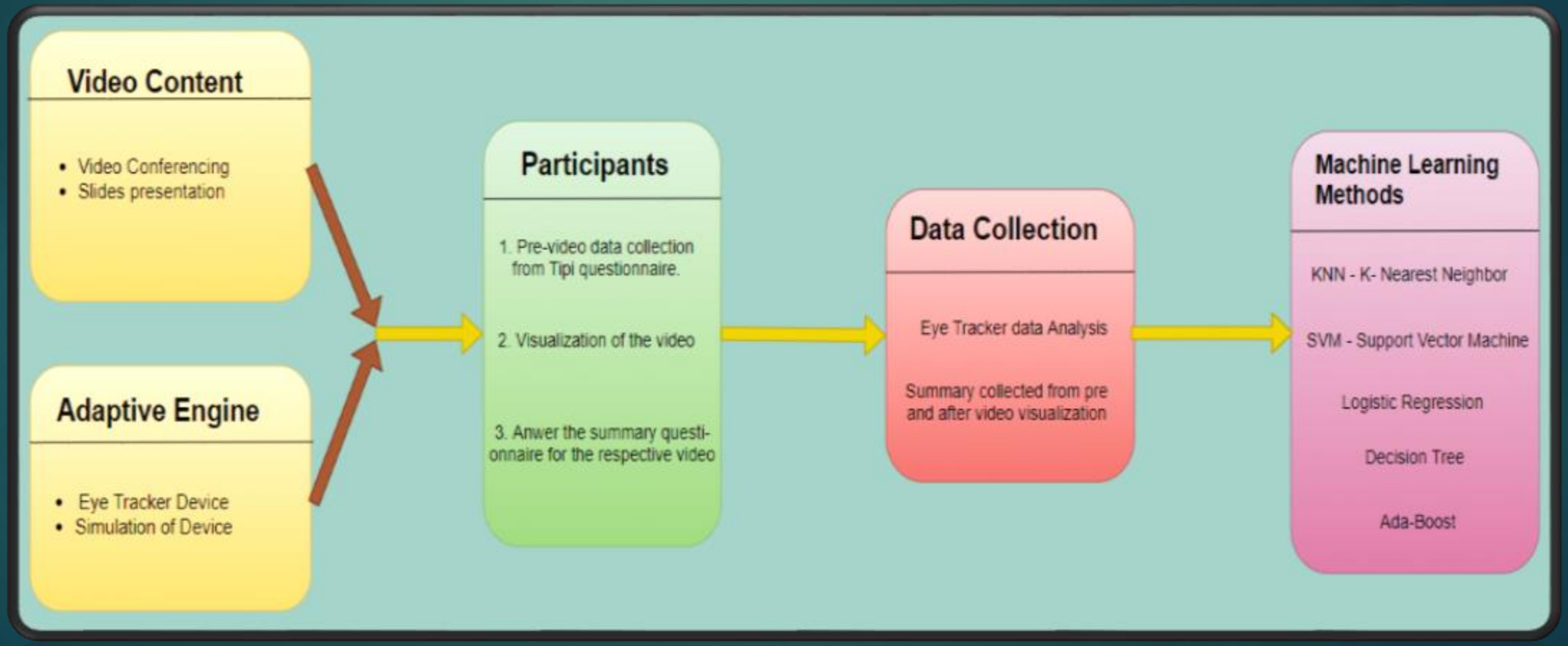
Related Work

- Detection of Mental Fatigue – Wearable Eye Tracker Device, EEG (ectroencephalogram) signals, Physiological sensors
- Mental Fatigue and Measures of Eye Tracking device – PERCLOS, Oculomotoric parameters, KSS, SSS, NASA –TLX
- Zoom Fatigue – ZEF (Zoom Exhaustion and Fatigue) scale.

Eye Tracker Device



Experimental procedure



Data Acquisition

- Features from Eye Tracker Device
- (frequency, count, total and average duration)
- Blink
- Visual Intake
- Saccade

Features from Questionnaire

- Age
- Gender
- KSS
- SSS
- Summary Test Results

Data Pre-Processing

- Two excel files were generated for this research :
  1. Event_stats_v1.Xlsx (data extracted from eye tracker device)
  2. Participants.Xlsx (data extracted from questionnaire)
- These files were merged using unique participant identification number.
- Calculation of perclos

$$PERCLOS = \frac{blink + CLOS}{interval}$$

Evaluation

- The aim of this research is to detect zoom fatigue using the proposed MLETF
- Hence, for evaluation we will implement machine learning algorithm over the data collected by eye tracker device and the response from questionnaire
- Five machine learning algorithms, SVM, KNN, Logistic Regression, Decision Tree and Ada-Boost were considered
- Four experiments were performed, to analyze and compare performance of different machine learning algorithms

Experiment 1

Implementation of data collected from eye tracker device

- The data extracted from eye tracker device, count, frequency and duration of blink, saccade and visual intake are considered

Machine Learning model	Accuracy
SVM	0.43
Logistic Regression	0.43
KNN	0.71
Decision Tree	0.29
Ada-Boost	0.29

Experiment 2

Implementation of data collected from eye tracker device and PERCLOS

- The data extracted from eye tracker device, and PERCLOS are considered

Machine Learning model	Accuracy
SVM	0.43
Logistic Regression	0.43
KNN	0.57
Decision Tree	0.29
Ada-Boost	0.29

Experiment 3

Implementation of data collected from eye tracker device and response from questionnaire

- The data extracted from eye tracker device, and questionnaire that are age , gender, SSS, and score obtained from summary test are considered

Machine Learning model	Accuracy
SVM	0.71
Logistic Regression	0.71
KNN	0.57
Decision Tree	0.71
Ada-Boost	0.86

Experiment 4

Implementation of data collected from eye tracker device, response from questionnaire and calculated PERCLOS

- The data extracted from eye tracker device, data from questionnaire , and PERCLOS are considered

Machine Learning model	Accuracy
SVM	0.71
Logistic Regression	0.71
KNN	0.57
Decision Tree	0.57
Ada-Boost	0.71

Discussion

- Experiment 1 where we have considered only the data extracted from eye tracking device, KNN has shown highest accuracy of 71%
- Experiment 2 where we have considered data extracted from eye tracking device and perclos, knn has shown the highest accuracy of 57%
- Experiment 3 where we have considered data extracted from eye tracking device and questionnaire, ada-boost has shown highest accuracy of 86%
- Experiment 4 where we have considered data extracted from eye tracking device. Questionnaire and PERCLOS, ada-boost has shown highest accuracy of 71%

Conclusion and Future Work

- The proposed MLETF for detection of zoom fatigue has shown good performance with accuracy of 86% using Ada-boost
- Inclusion of PERCLOS in the dataset has reduced the performance for detection of zoom fatigue
- For future work addition of more eye feature such as pupil dilation, frequency etc. Can be considered. We can also evaluate the impact of increasing the size of dataset, video length and distance between eye and screen for detection of zoom fatigue

Thank You

Q & A