Detection of Mind-Wandering through Sound

TU Delft – Research Project CSE3000
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1. Background

Mind-Wandering (MW): "The executive components of attention appear to shift away from the primary task [1], not due to external factors or the person interacting with the external environment"

- In alignment with existing literature
- Reflects difference between Mind-Wandering and Distraction
- Mementos data set [2]

2. Research

- 96% of adult Americans experience mind-wandering daily, takes up nearly 50% of the day [3]
- Methods: self reports, thought probes, electrophysiological measures, eye tracking

3. Useful for

- Understanding attention control mechanism
- Enhancing the effectiveness of attention training

4. Research Questions & Hypothesis

RQ: "Is detection of mind-wandering with audio feasible?"

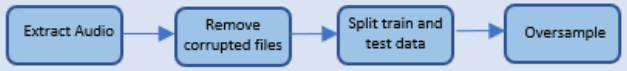
Sub questions:
- Effect of wearing headphones?
- Accuracy?
- vs other techniques?

Hypothesis: External Sound is more useful in detecting cases of non-mind-wandering than mind-wandering

5. Method

1) Annotating video data (VGG)
- Creating ground truth values
- Rule book
- Removing videos

2) Pre-processing



3) Audio Feature Extraction
- Spectral Envelope Representations
- Perceptual Features
- Chroma Features

4) Mind-wandering Classification

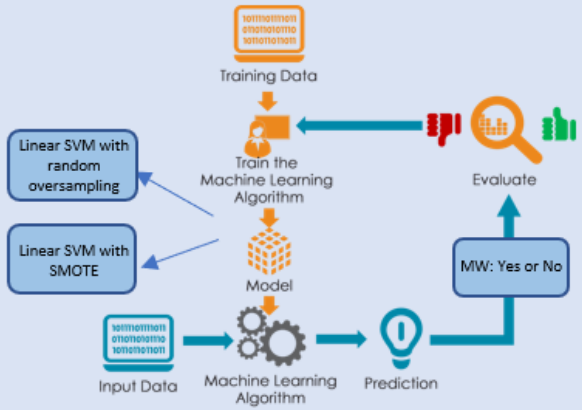


Figure 1: Results with oversampling

Confusion matrix, acc = 79.5%, F1 (macro): 54.1%		
	MW	NO-MW
MW	4	7
NO-MW	17	89

Table 1: Confusion Matrix results with oversampling

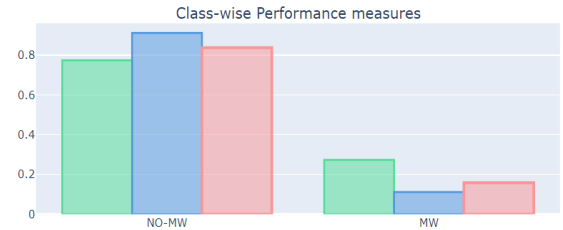


Figure 2: Results with SMOTE

Confusion matrix, acc = 72.6%, F1 (macro): 49.7%		
	MW	NO-MW
MW	3	8
NO-MW	24	82

Table 2: Confusion Matrix results with SMOTE

6. Results & Discussion

- Low metric scores regarding mind-wandering detection
- No indication of correlation between wearing headphones or not
- Lower metric values are obtained for detecting mind wandering, which is likely due to the imbalance in the non-mind-wandering and mind-wandering test data, and due to the low amount of data
- Other techniques experimented with in the past are more reliable
- Not enough results to conclude the hypothesis holding

Future Work:
- Non-binary mind-wandering classification, rather a confidence score
- Oversampling in combination with under sampling

7. References

[1] Jonathan W. Schooler et al. "Meta-awareness, perceptual decoupling and the wandering mind", 2011
[2] B. Dudzik et al. "Collecting Mementos: A Multimodal Dataset for Context-Sensitive Modeling of Affect and Memory Processing in Responses to Videos"., 2020
[3] Jerome L. Singer and Vivian G. McCraven. "Some Characteristics of Adult Daydreaming", 1961

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