Multimodal learning analytics on sustained attention by measuring ambient noise?

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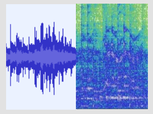
1 - Background

- Estimating learners attention during a learning task
- Help teachers improve learning material (Schneider et al. 2015)
- Help students stay focused (Schneider et al. 2015)
- Multiple sensors to detect distraction, spread over 4 researches
- Focus on ambient noise in learning environment
- Sound can distract a focused human (Ke et al, 2021; Lee, 2019; Morgan, 1917)
- Distracting aspect of sound: fluctuation in frequency (Perham et al, 2007)

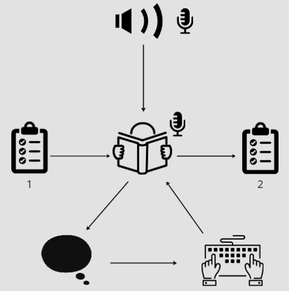


2 - Questions

- **How can noise sensing aid in a multi-modal analytics tool to track sustained attention?**
- What should be measured on the noise (dB, Hz, Hz fluctuation or categorized sounds) ?
- Should background noise be filtered to reliably determine if a noise is distracting?
- If the background noise needs to be filtered, how can this be filtered without losing possible noises that distract a learner?
- Can a correlation between noise variation and distraction reliably be found in the microphone recordings by studying the sound levels (dB) and fluctuation in sound frequency (Hz) and what is this correlation?
- How does the possible correlation between noise variation and distraction help the multi-modal analytic tool to track sustained attention ?

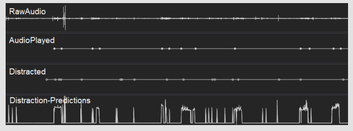
3 - Method

- Due to COVID: experiment conducted on 3 researchers
- Participant reads a long article (45—90 minutes)
- During experiments, 9 different sounds are played at random
- (3 fluctuating tone, 1 focus sound, 1 scary sound, 1 white/background noise, 1 vocal free song, 1 machine, 1 construction sound)
- Subject presses button when distracted
- Ambient sound recorded using two microphones (Lavalier microphone and earphones microphone)
- Questionnaire made before and after experiment

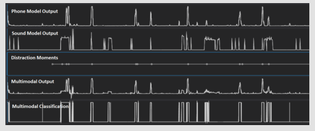


4 - Results

- No correlation found manually, machine learning necessary
- Kerbal model learned using Tensor Flow, classification model
- 60 audio fragments, 30 distracting, 30 non-distracting
- 80% training, 10% validation, 10% testing
- 61% accuracy, dataset not big enough
- Multi-modal model created with mobile movement model
- Weighted averages when mobile movement model does not detect a distraction
- Mobile movement model when predicts distraction



Uni-modal model



Multi-modal model

5 - Conclusion & Future work

- Results seem promising
- Correlation between sound spectrograms and distraction seems to exist
- Further research with bigger dataset and more diverse participant group necessary to confirm claim
- In current form, noise sensing can aid in a multi-modal analytics tool by adding some points it is certain about, but other algorithm does not pick up
- In future research, if accuracy of model increases, can help mobile movement model even if it predicts a distraction to increase multi-modal models accuracy

Link to report

6 - Acknowledgment & References

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