Detecting Spatial Orientation Demands
during Virtual Navigation using EEG Brain Sensing

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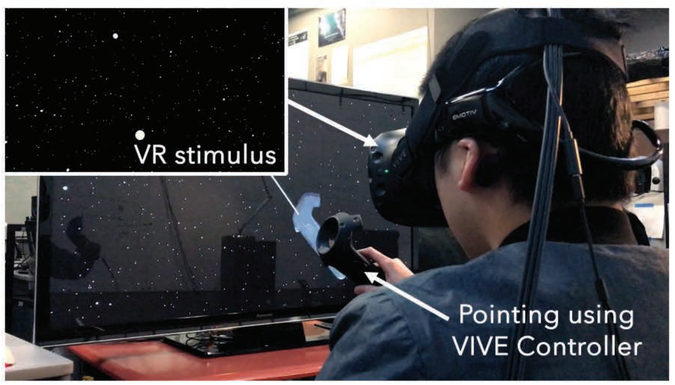
MOTIVATION

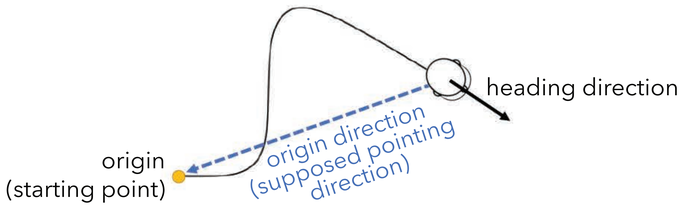
Spatial Disorientation is a major issue in Virtual Reality (VR) that affects both user experience and users' behavior *negatively*.

- In this study, we aimed to design and implement an AI-based software that can **automatically detect when users encounter challenges in spatial orientation** during their locomotion in VR (having high demands of spatial orientation).

TASK: POINT-TO-ORIGIN



Participants passively navigated through a predefined trajectory including straight and curvy segments. In half of the trials, participants were asked to point back to the origin after the visually simulated excursion (high orietnation demand), in the other trials they did not (control condition).



RESEARCH QUESTIONS

Can we use a simple consumer-grade electroencephalogram (EEG) headband to detect whether/when users encounter difficulties in maintaining their spatial orientation in VR?

Yes!

Can we "teach" the computer to do that automatically?

Yes!

METHOD

Dataset of EEG in two conditions, (1) high orientation demand and (2) normal, has been collected in point-to-origin task.

A deep learning technique called *Convolutional Neural Network (CNN)* has been used to "learn" the collected data.

Detection accuracy has been tested using *three-fold cross validation*. Results demonstrate that we can indeed use CNN to detect spatial orientation demands in EEG data with **96%** accuracy on average.

CONCLUSIONS

This study provides a more **objective** and **automatic** approach to assessing spatial orientation demand in VR.

The results suggest the feasibility of combining **EEG brain sensing** and advanced **machine learning techniques** in evaluating human spatial orientation in VR.

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[3] Kahana, M. J., Sekuler, R., Caplan, J. B., Kirschen, M., & Madsen, J. R. (1999). Human theta oscillations exhibit task dependence during virtual maze navigation. Nature, 399(6738), 781–784. https://doi.org/10.1038/21645

Proudly presented at
Psychonomic Society 58th Annual Meeting