

Prediction and Adaptive Control of Cybersickness in Virtual Reality Environments Using Machine Learning

Predikce a adaptivní řízení kinetózy ve virtuální realitě s využitím strojového učení

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Abstract:

Virtual reality is an important area of information technology, but its wider adoption is limited by cybersickness, a set of physiological and perceptual symptoms associated with interaction with virtual environments.

The aim of this doctoral thesis is to design and experimentally validate a method for intelligent prediction and adaptive control of cybersickness using machine learning. The research will investigate relationships between users' behavioural and movement characteristics in virtual environments and the occurrence or intensity of cybersickness symptoms. An experimental VR environment will be implemented for the Meta Quest 3 headset using Unity and OpenXR. During controlled experiments, users' head and controller movements, position and orientation, speed, acceleration, changes in direction, locomotion methods, and other temporal characteristics will be continuously recorded.

Subjective assessments of discomfort and cybersickness symptoms will be collected simultaneously. The collected data will be used to identify significant predictors and temporal patterns associated with cybersickness. Machine learning methods will be evaluated to develop a model capable of continuously estimating an individual user's risk of cybersickness. Particular attention will be paid to prediction accuracy, robustness, response time, generalisation across users, and model interpretability. Based on the predictive model, an adaptive control mechanism will be developed to modify selected parameters of the virtual environment in real time.

Possible adaptations will include changes in movement speed or acceleration, limiting sudden changes in direction, modifying visual stimulation, or selecting a more suitable locomotion method. The effectiveness of adaptive control will be experimentally compared with static VR settings. The principal scientific contribution will be a validated method for predicting and adaptively controlling cybersickness based on continuous analysis of user behaviour and movement. The research will contribute to understanding the relationship between behavioural dynamics and cybersickness and to the development of intelligent, personalised VR systems.

Literature:

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