CyberScore: Measuring Sickness Susceptibility in Virtual Reality

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Problem Statement

Currently, no **standardized** virtual environment exists to measure cybersickness susceptibility in a comprehensive and generalizable way; instead, individuals must rely on **isolated** and **inconsistent** Virtual Reality (VR) experiences to gauge their own sensitivity.

Background

VR is **widely** used in gaming and entertainment, with growing adoption in education, job training, and therapy.

Cybersickness (characterized by symptoms of **nausea**, **oculomotor discomfort**, **disorientation**) remains a **significant** barrier of VR use.

Measuring cybersickness is difficult due to:

- High individual **variability**
- **80+ factors** that go into its facilitation
- Complexity of **multi-source** data collection (self-reports, physiological, behavioral)

No **unified** scoring formula exists to quantify cybersickness consistently across users and studies.

This lack of standardization **limits** cross-study comparisons and slows progress in developing solutions.

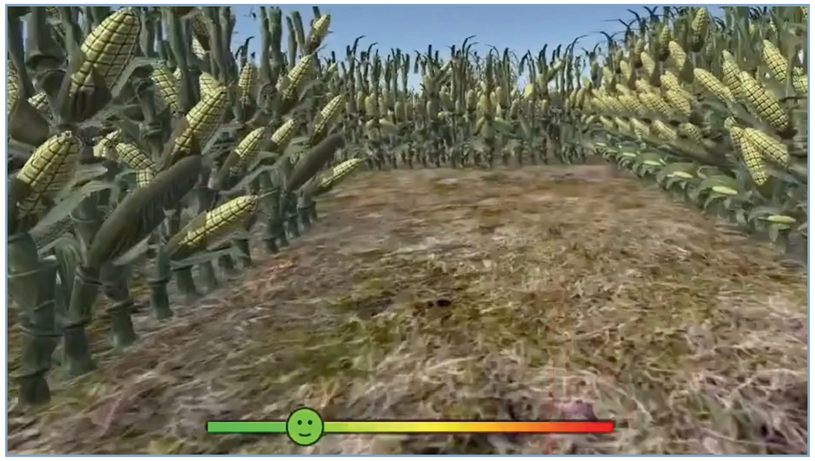

Figure 1. *Corn Maze Screenshot with Cybersickness Meter*

Methods

CyberScore collects both **subjective** and **objective** data with the goal of combining them into one composite score. The subjective data comprises of the Simulator Sickness Questionnaire (**SSQ**) and Fast Motion Sickness (**FMS**) meter. The objective data was derived from the **EmotiBit** (heart rate, electrodermal activity, skin temp.) and the **Varjo XR-3 VR** headset (head movement and eye tracking).

Scoring Methods Under Consideration:

- **Weighted** composite score *(w = weight, F = factor scene)*
  - $w_1F_1 + w_2F_2 + w_3F_3 + \ldots$
  - Later factors hold higher weights (i.e., $w_3 > w_1$)
- **Average** of FMS scores
  - Combine FMS average across all scenes
- Rate of change (**acceleration**) in FMS scores
  - Compare FMS changes between each scene
- General Fast Motion Score (**GFMS**):
  - $FMS_{Average\ t \in [0,SceneEndTime]} * (FMS_{t=SceneEndTime} - FMS_{t=0})/10$

The methods will be evaluated through pilot studies to determine the most effective version for yielding the most accurate score.

Predicted Results

Simulated FMS data show increasing discomfort across the six VR scenes.

Early scenes have **lower**, more consistent symptom ratings

Later scenes (especially Scenes 5 and 6) show **higher** symptom levels and greater variability.

This trend suggests **increasing** cybersickness sensitivity as participants progress through the experience.

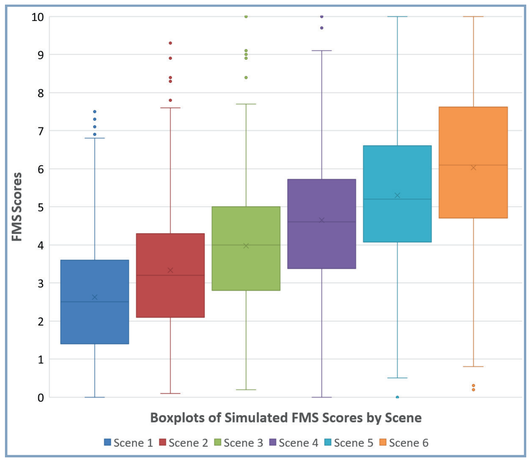

Figure 3. *FMS scores across all 6 scenes*

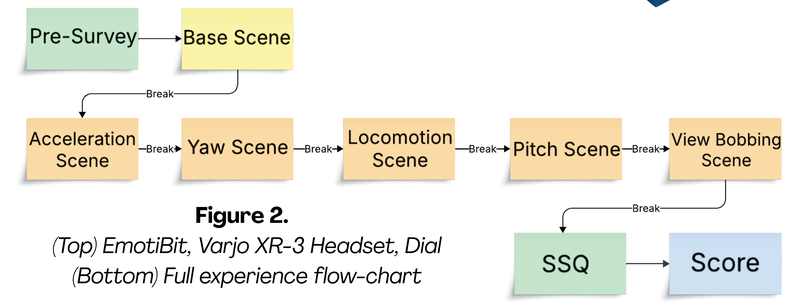

Figure 2.
(Top) EmotiBit, Varjo XR-3 Headset, Dial
(Bottom) Full experience flow-chart

Discussion

The predicted results aims to categorize individuals into **three** different groups of cybersickness susceptibility levels: low medium, and high. Alongside these groups, they will address the **demographic** correlations, i.e. gamers being less susceptible.

By focusing on a targeted set of key factors, CyberScore addresses challenges of high individual variability and complex multimodal data collection. CyberScore utilizes scoring methods like weighted composites and time-based metrics to create a **consistent**, scalable cybersickness score.

Conclusion and Future Work

CyberScore can serve as a **pre-screening** tool in future studies to identify and exclude participants whose data may be **unreliable** or **unusable**.

The current version relies on additional hardware, such as the EmotiBit and Varjo eye-tracking headset, which can limit its **accessibility** to other institutions.

Future iterations should minimize or eliminate the need for such equipment by developing a CyberScore based primarily on **subjective** data from the FMS and/or SSQ, enabling broader adaptation of the technology and maintain general utility, though with less precise results.

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