



Exposing virtual reality's navigation aids with behaviour-based prediction model

Author: Pachara Chairungsi
Advisor: Dr. Sutasinee Thovuttikul

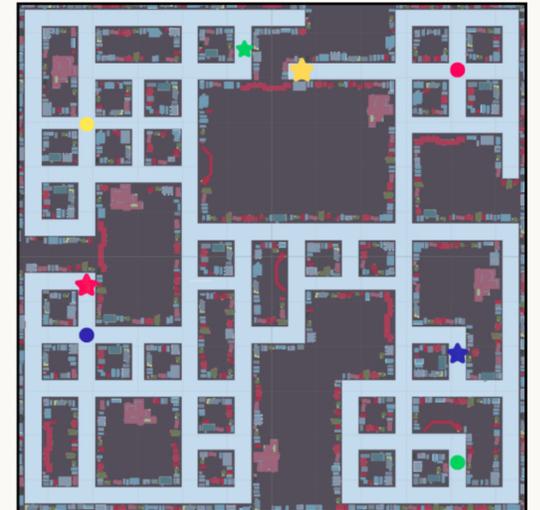
Abstract

Systems that involve exploration in large environments can cause users to experience anxiety and uncertainty due to disorientation. This issue is resolved in conventional screen-based systems by incorporating navigation aids in the user interface, such as displaying a mini-map or an arrow on the screen. However, implementing the same approach in *Virtual Reality (VR)* systems can decrease the user's sense of immersiveness, which is a main component of *VR*. This independent study gathers datasets of head changes and movement speeds to explore whether participants feel disoriented or not. The methodology in this study consists of two steps. First, collect behavioral data from participants using Unity Engine, with an Oculus Quest 3 as the data collection device. Second, use the datasets to develop a *Long-Short Term Memory (LSTM)* model. The model was trained using head movement and movement speed datasets from 22 participants can classify whether users experienced anxiety due to disorientation.

Introduction

Virtual Reality is implemented in both gaming and specialized applications by creating immersive environments that users can naturally interact with. Users can control their viewpoint through intuitive head movements, making it feel more like exploring the real world. This natural interaction helps users better understand and process their virtual surroundings. Traditional applications rely on constant UI to guide users. but UI overlays in VR can break immersion by blocking the user's view and pulling attention away from the virtual world. To solve this issue, researchers are developing prediction models to detect whether users are feeling lost.

(Alghofaili, 2019) have created models that use gaze direction to determine when navigation assistance should be provided to users. Studies have shown these models can effectively predict moments when players are feeling lost in virtual environments. Additional factors like head orientation and movement speed have been represent as indicators of user disorientation.



Methodology

I. Data Gathering: Collect Data while participants play VR

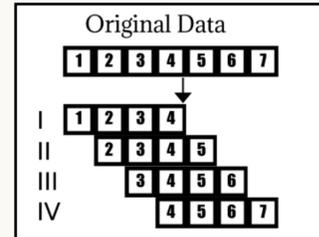


The VR simulation is created to monitor behaviour of participant to explored to objective, and navigate back to spawnpoint. Navigation aids were exposed at first-half, and disappeared in the last task.



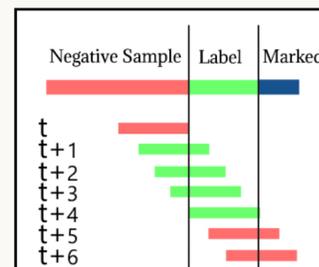
During navigating back to spawnpoints, participants can enable navigation aids for a moments. By this process, the datasets marked at that moment as "participant is feeling lost in this interval time".

II. Data Preprocessing & Model Training



Sliding Window

The collected datasets convert into sequences with sliding window technique. To get input into time series forms. The amount of sequence is 350 rows (7 seconds x 50 data per seconds) .



Labelling

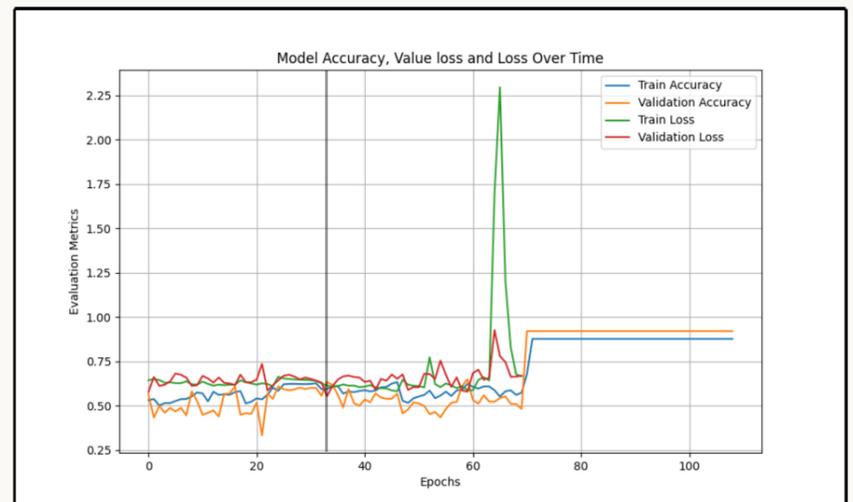
We label positive samples by selecting any sequence that intersects with the 7 seconds preceding a marked sequence. As the figure shown, the green area is the mentioned 7 seconds. And the blue area is marked sequence.

Technology



Train With LSTM Model

LSTM model is trained, with the preprocessed dataset for 110 epoches and select the network that have the least **validation loss**, at 34th.



Conclusion

- The results show accuracy of 0.6337.
- The positive samples still in varies.
- To improve data consistency, future works should improve the data collection protocol and provide clearer instructions to participants.

0	94917	55211
1	4484	8375
	0	1

References

Alghofaili, R., Sawahata, Y., Huang, H., Wang, H. C., Shiratori, T., & Yu, L. F. (2019, May). Lost in style: Gaze-driven adaptive aid for vr navigation. In Proceedings of the 2019 CHI conference on human factors in computing systems (pp. 1-12).
Ishikawa, T., & Montello, D. R. (2006). Spatial knowledge acquisition from direct experience in the environment: Individual differences in the development of metric knowledge and the integration of separately learned places. *Cognitive psychology*, 52(2), 93-129.

