Design and Evaluation of Travel and Orientation Techniques for Desk VR

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Why we chose this paper?

01

Past experiences with VR

02

Curiosity

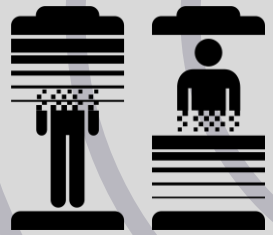
03

Relevance of the topic

Current navigation techniques

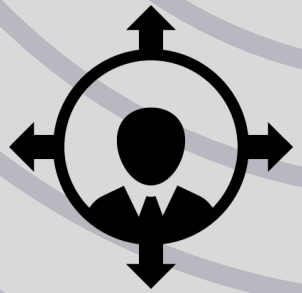
Continuous

Discrete



Travel

Orientation

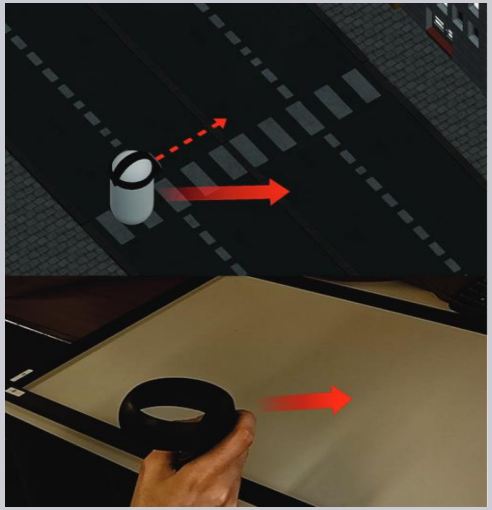
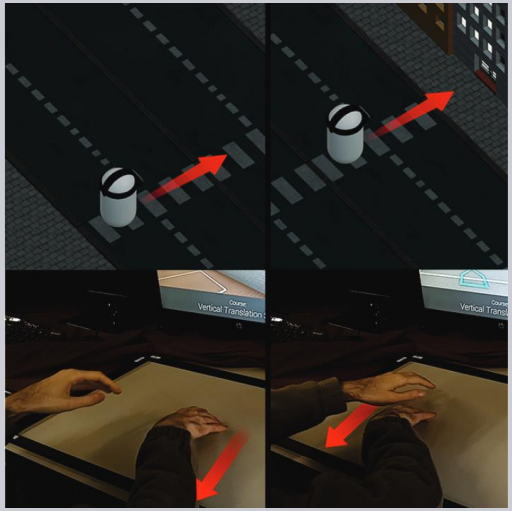
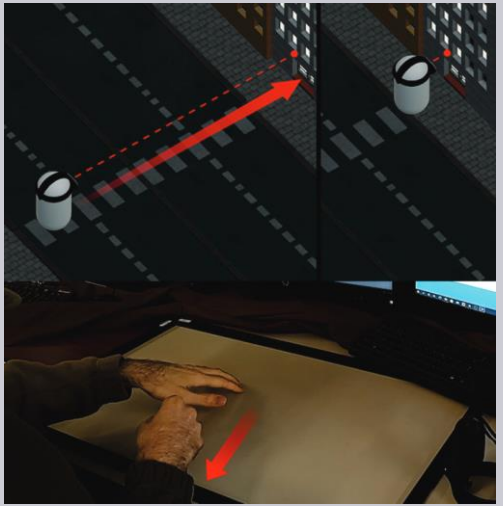


Cybersickness

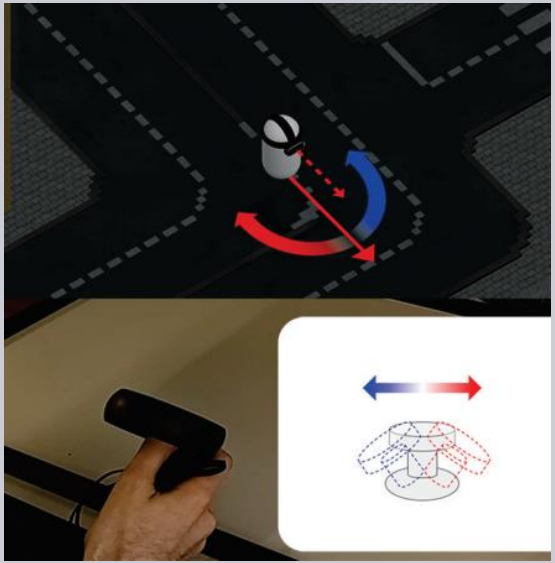
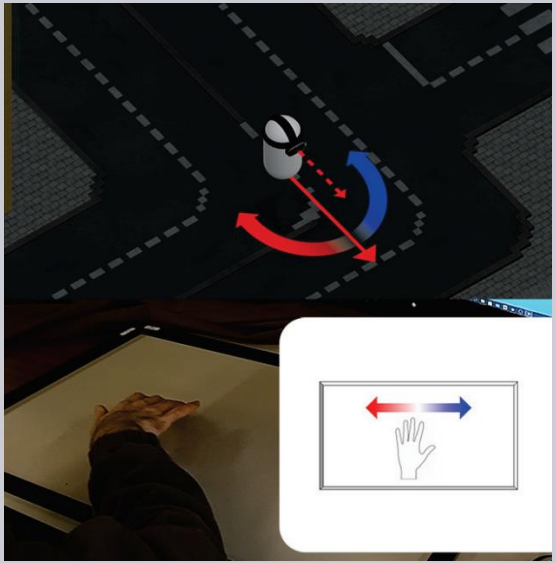
- One of the biggest problems introduced by VR
- Especially noted when user is seated
- Short movements don't cause as much cybersickness so movement time should be set to a maximum of 300ms

Proposed Techniques

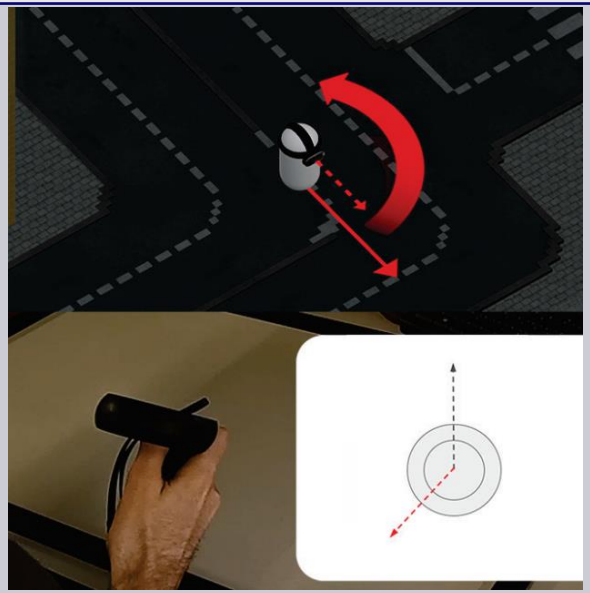
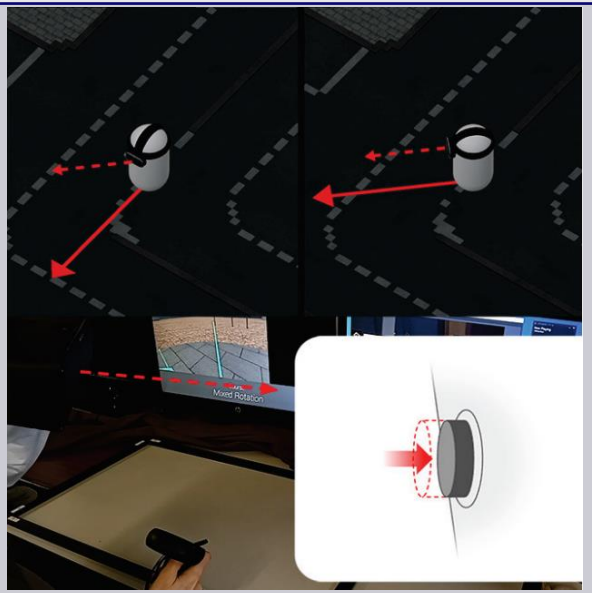
Travel

Continuous Directional Movement	Dog Paddle	Drag'n Go
		
Point the VR controller in the direction of the movement.	Repetead gestures on a touch surface to move the user in the direction of his gaze.	Similar to Dog Paddle but the final position is determined when the gesture begins.

Orientation

Continuous Directional Rotation	Tactile Surface Dragging
	
Use an analog stick to indicate the direction of rotation, which is applied over the vertical axis of the user.	The user do a gesture over a tactile surface and convert it into rotation over the vertical axis of the virtual body.

Orientation

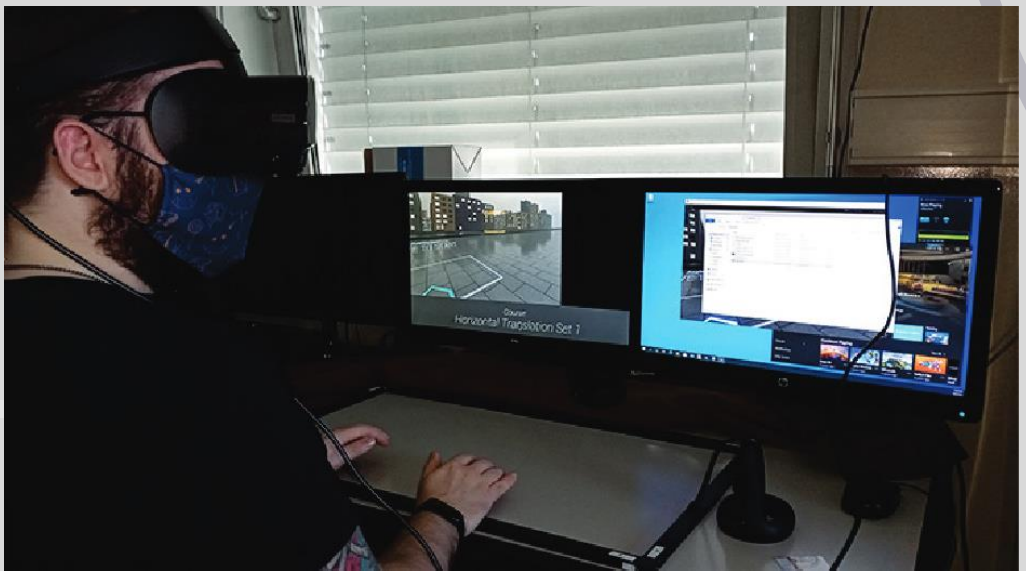
Choose & Click	Gaze Convergence
	
Point to the final direction of rotation using the analog stick. After defining the directions, the user can press the button to confirm.	Use of the final orientation of the head instead of the analog stick and then press the button to confirm the rotation.

User Evaluation

Prototype

Unity 2020.3.19

Oculus Rift S



Superfície multi-touch 32”

Participants

12

5 ♀ 7 ♂

8 No experience with VR

2 <1 / month

2 daily

8 18-25

3 26-32

1 49-62

1 Vertigo

Method

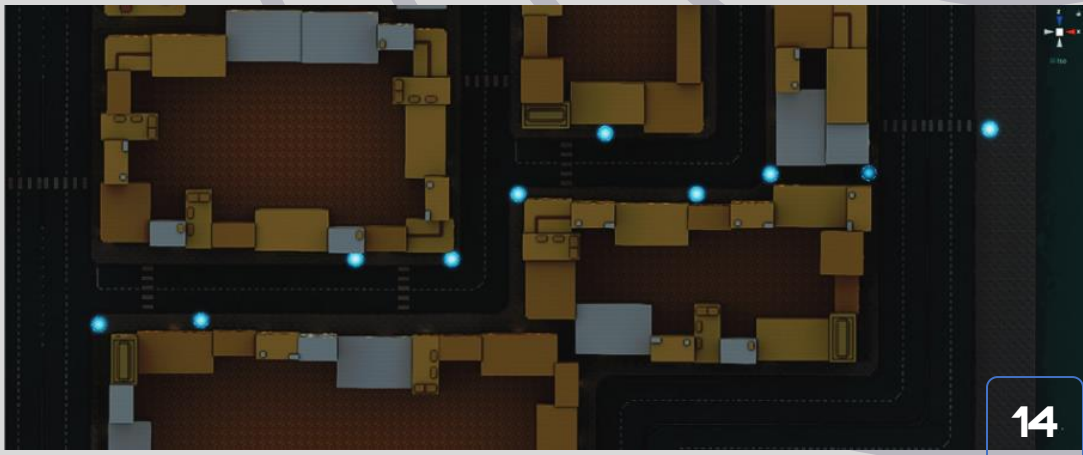
- Followed a Balanced Latin Square distribution
- 1 minute to explore freely
- 45-60 minutes to complete the tasks, then a break
- Questionnaire evaluating user satisfaction, workload and comfort tax, following standards like SUS and NASA-Task Load Index
- 16 questions, including overall rating and cybersickness
- Time, distance traveled and total rotation recorded

Tasks

- 4 movement and 3 orientation tasks repeated for each technique
- User had information about next checkpoint, including an arrow pointing towards it and checkpoint number
- Depending on category (movement or orientation), the other one was locked
- Time started in the first movement made by user

Movement Tasks

a) Mixed task, with horizontal and vertical movement

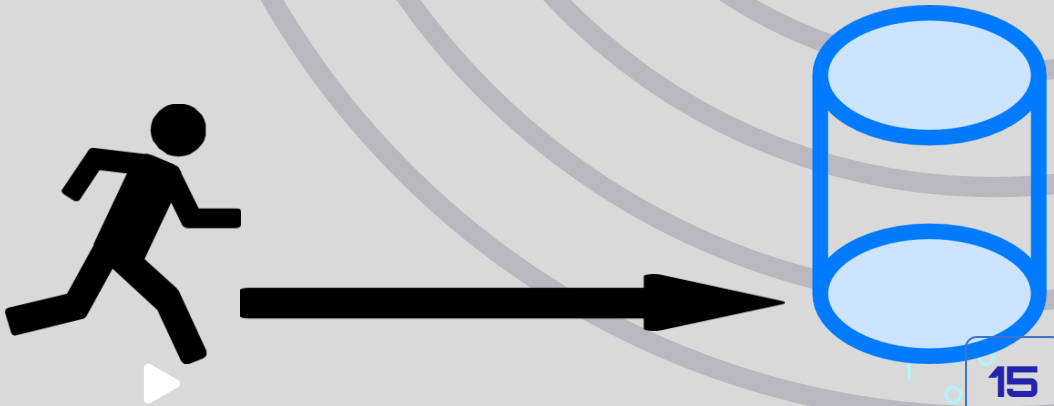


b) Horizontal movements on plane environment

Movement Tasks

c) Vertical Movements to test obstactle bypassing

d) 1 distant checkpoint with no movement restrictions



Orientation Tasks

a) 7 checkpoints with various rotations

b) Small rotations

c) Big rotations

Results

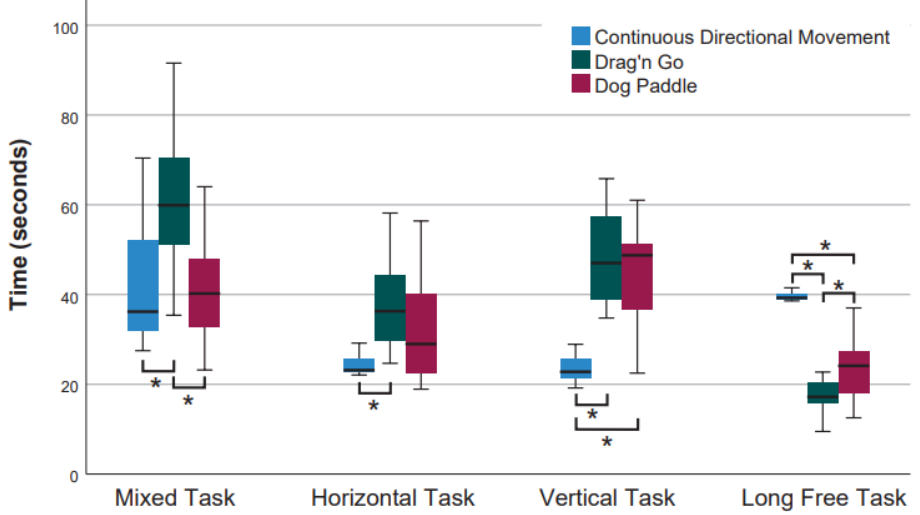
Travel tasks

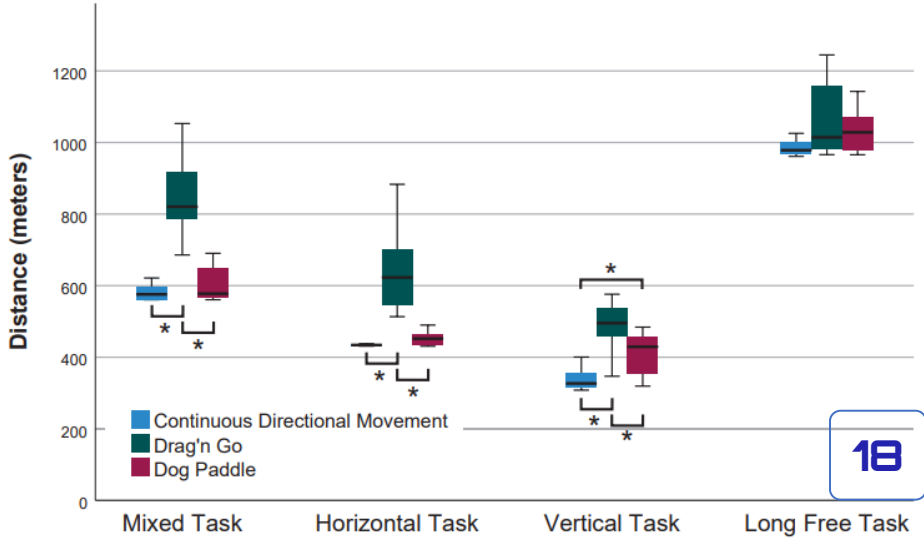
Time:

- **Mixed task:** DnG is slower than both CDM and DP
- **Horizontal task:** only CDM is faster than DnG
- **Vertical task:** CDM is much faster than both DnG and DP
- **Long task:** DnG is faster than both DP and CDM

Path length:

- **Mixed, Horizontal and Vertical tasks :** DnG had a larger path than both CDM and DP
- **Long task:** no diferences between the proposed techniques





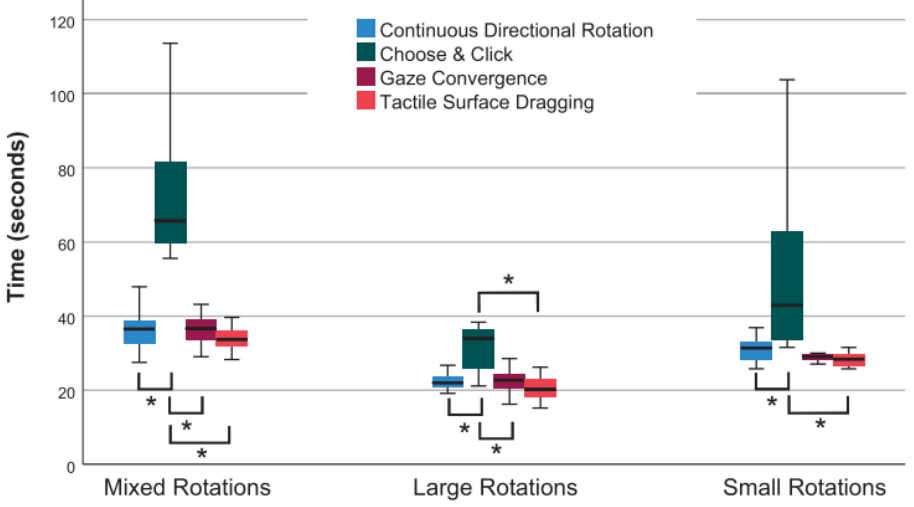
Orientation tasks

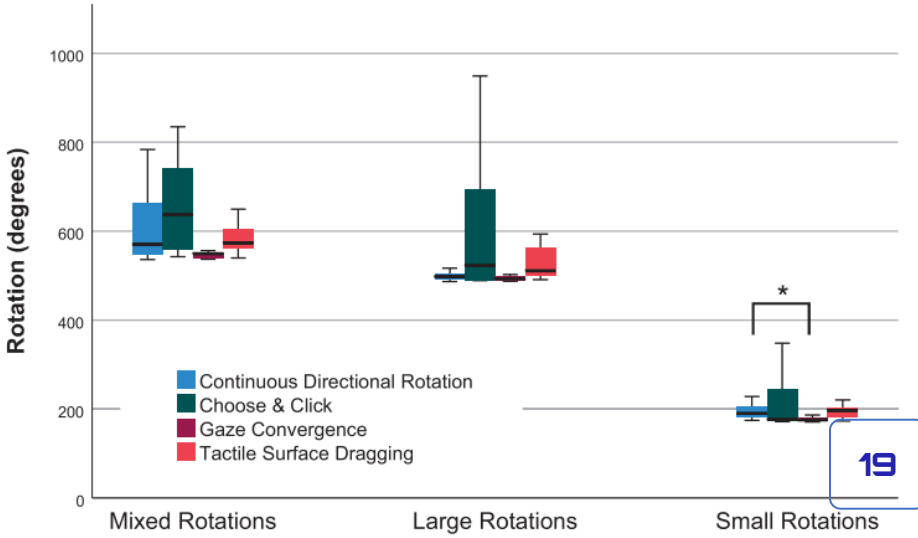
Time:

- **Mixed and Large Orientation tasks:** C&C performed worse than GC and TSD
- **Small Orientation task:** C&C performed worse than CDR and TSD

Total Rotation:

- **Small Orientation task:** GC had a smaller total rotation than CDR





Questionnaire Results and Discussion

Question	Travel			Orientation			
	CDM	DnG	DP	CDR	C&C	GC	TSD
How well do you think you performed?	7(1)*	5(1)*†	6(3)†	6.5(1)*	4.5(2)*†‡	6(1)†	6.5(1)‡
How much effort did it require to reach your level of performance?	1(2)*	3.5(2)*	3.5(4)	1(2)*	5(2)*†	3(4)	2(2)†
How do you feel about your performance?	7(1)*	4.5(3)*	6(3)	7(1)*	3(3)*†	6(2)	7(1)†
How mentally demanding was the task?	1(1)*	3(3)*	2(3)	1(1)*	3.5(3)*†	2(3)	1.5(1)†
How physically demanding was the task?	2(1)	2(2)	3.5(4)	1(1)*	2.5(2)	3(4)*	1.5(2)
How rushed was your pace on the task?	1(3)	3(4)	3.5(5)	1(4)	4(2)	4.5(4)	2(4)
I would like to use this technique frequently.	4(1)	3(3)	3(3)	5(2)	3(2)	4.5(3)	4(3)
I found the technique unnecessarily complex.	1(0)	1(1)	1.5(2)	1(0)	2.5(3)	1(1)	1(0)
The technique was easy to use.	5(0)*	4(2)*	4(2)	5(0)*	3(2)*†	5(2)	5(0)†
I think that I would need the support of a technical person to be able to use this technique.	1(1)	1(2)	1(1)	1(0)	1(1)	1(1)	1(0)
I would imagine that most people would learn to use this technique very quickly.	5(1)*	4(2)*	4(2)	5(0)	3(3)	4(2)	5(1)
I found the technique very cumbersome to use.	1(1)	2(2)	2(3)	1(1)	3(4)	1.5(3)	1(0)
I felt very confident using the technique.	5(1)	4(2)	4(2)	5(0)	3(2)*	4.5(2)	5(0)*
I needed to learn a lot of things before I could get going with this technique.	1(0)	1(1)	1(1)	1(0)	1(2)	1(1)	1(0)

Conclusion and Future Work

Conclusion and Future Work

- Desk VR limits the user interactions
- Increase the number of participants, improve the multi-touch surface hardware and use a surface with one or two controllers.
- Low participant number, but results provide good conclusions for further studies
- Symptom tax was low and user focus contributes to it

Thank you!

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