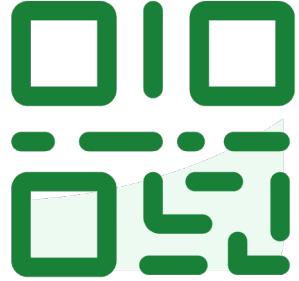


Industry Practices: Research Case Studies

Notes for the SIT-DP module: **Developing Immersive Applications**
Created by: Chek Tien TAN





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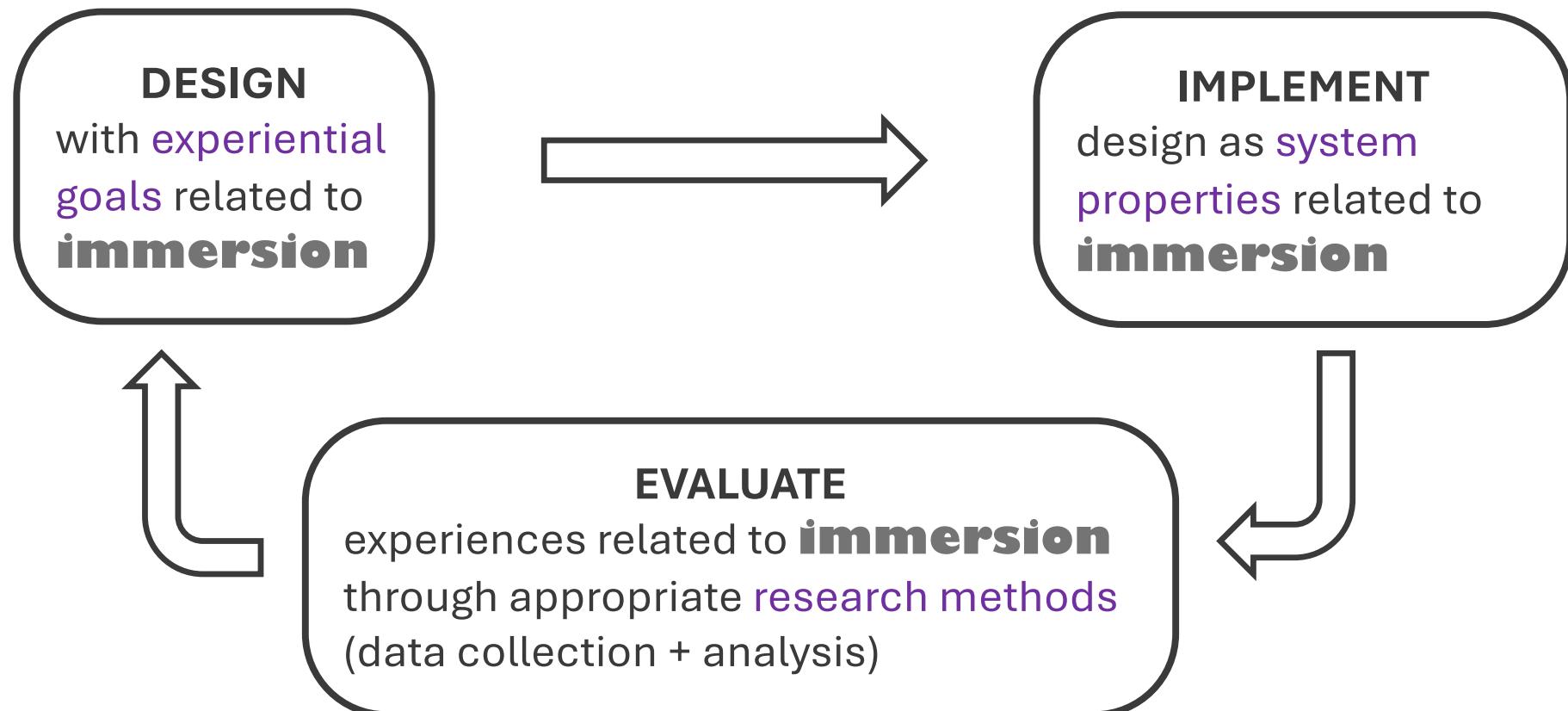
Join at slido.com
#123981273812

ⓘ Start presenting to display the joining instructions on this slide.

Learning Objectives

- appreciate the design and evaluation of immersive applications through real-world case studies
- understand how design translates into implementation through the lens of immersion
- understand how user study methods are used to achieve immersive experiential goals

Developing for **Immersion**



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Which of the following describes immersion from a systems perspective?

- ① Start presenting to display the poll results on this slide.

Which of the following describes immersion from a systems perspective?

Wide FOV



Higher spatial presence



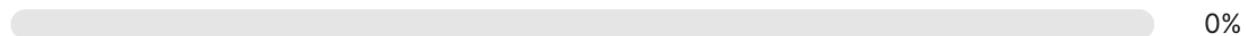
Sensor system for real-walking locomotion



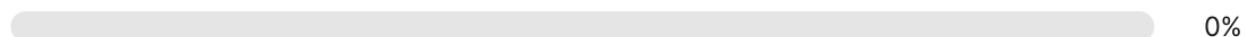
High-fidelity graphics



Lower cybersickness



6-DOF inside-out tracking



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**Which popular experiential
construct(s) of immersion is/are
relevant here?**

- ① Start presenting to display the poll results on this slide.

Which popular experiential construct(s) of immersion is/are relevant here?



https://youtu.be/ChYwDl4Ok_0

In our VR basketball game, we want users to forget about the fact that they are using the controllers as a proxy for their hands in VR. It should be like 2nd nature to them to catch, throw, etc. with the controllers. Also, users should not feel giddy in a fast paced match where they need to constantly look and run around the court.

Flow

0%

Presence

0%

Cybersickness

0%

Virtual Reality Commuting Simulator

Research Case Study 1

Designing for Immersion

It is first essential to consider all stakeholders of the application

- **Users** - the general public
 - that can come into a VR lab
 - who are interested to contribute feedback on commuting experiences
 - and perhaps curious about VR
- **Collaborator** - LTA
 - aim to have a VR system to evaluate commuting experiences
 - so as to obtain higher quality data and reduce operational costs

Designing for Immersion

- feel like actually in Singapore HDBs
[PRESENCE]
- locomotion close to real walking
[PRESENCE]
- clear goals and fluent performance
during commute
[FLOW]
- minimal nausea and disorientation
symptoms
[CYBERSICKNESS]



We ran workshops with the public to understand their problem and needs

Design → Implementation

feel like actually in Singapore HDBs
[PRESENCE]

replicate the scale and visuals of a real HDB estate



Real-world 3D Scans



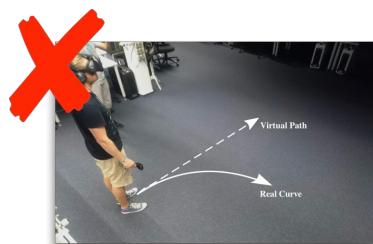
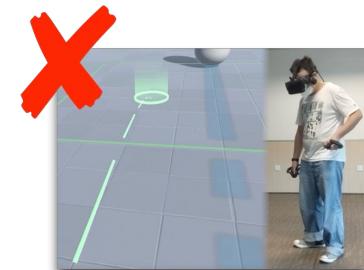
ArcGIS CityEngine



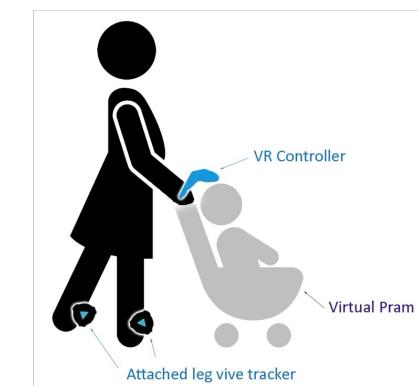
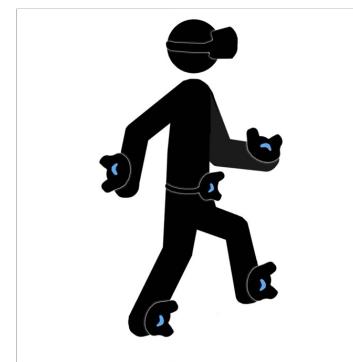
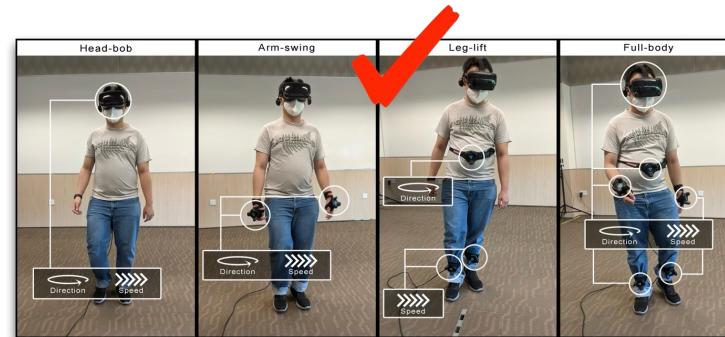
Design → Implementation

locomotion close to real walking
[PRESENCE]

clear goals and fluent performance
during commute [FLOW]



create a walking locomotion that is semi-natural yet
easy to operate



Design → Implementation

minimal nausea and disorientation
symptoms [CYBERSICKNESS]

reducing common pitfalls that induce visual-vestibular
conflict



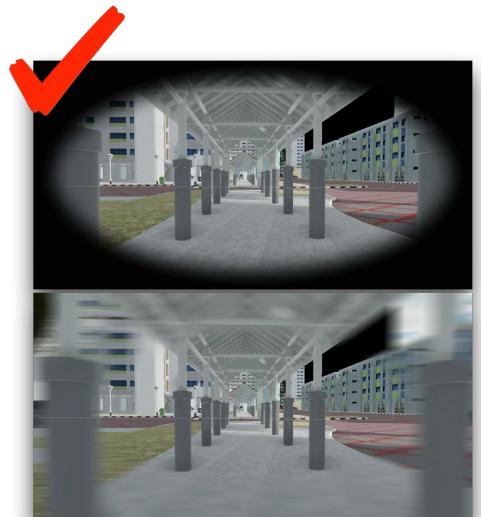
Joystick



Stationary



Walking Actions



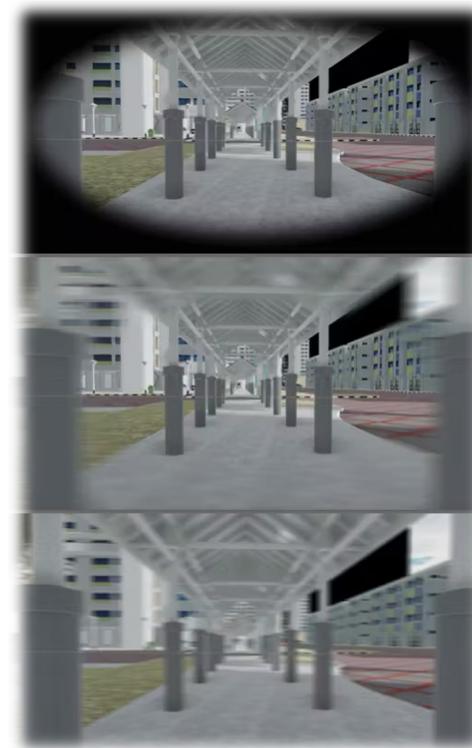
Visual mitigation
during movement

Design → Implementation

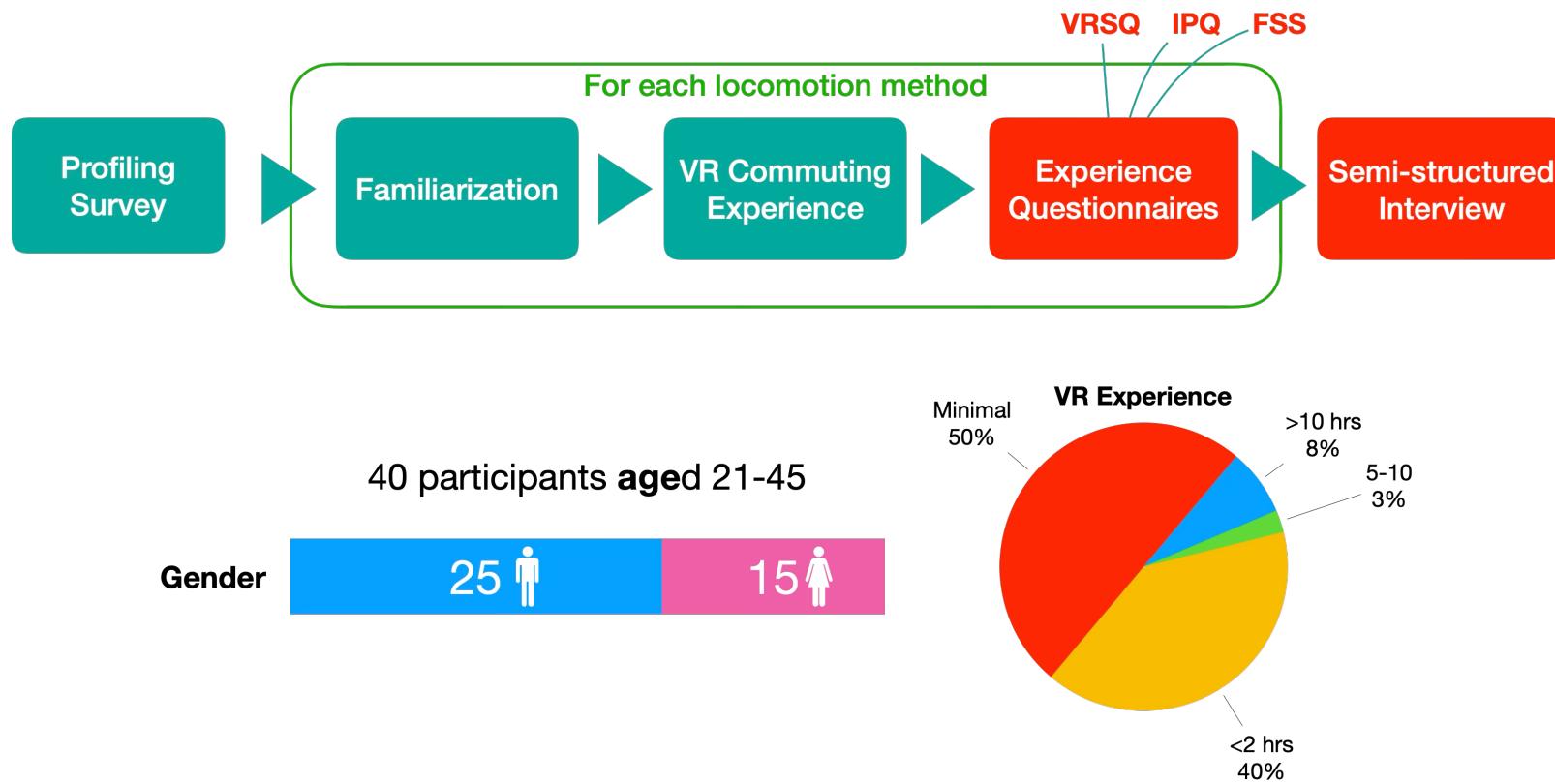
minimal nausea and disorientation symptoms [CYBERSICKNESS]

reducing common pitfalls that induce visual-vestibular conflict

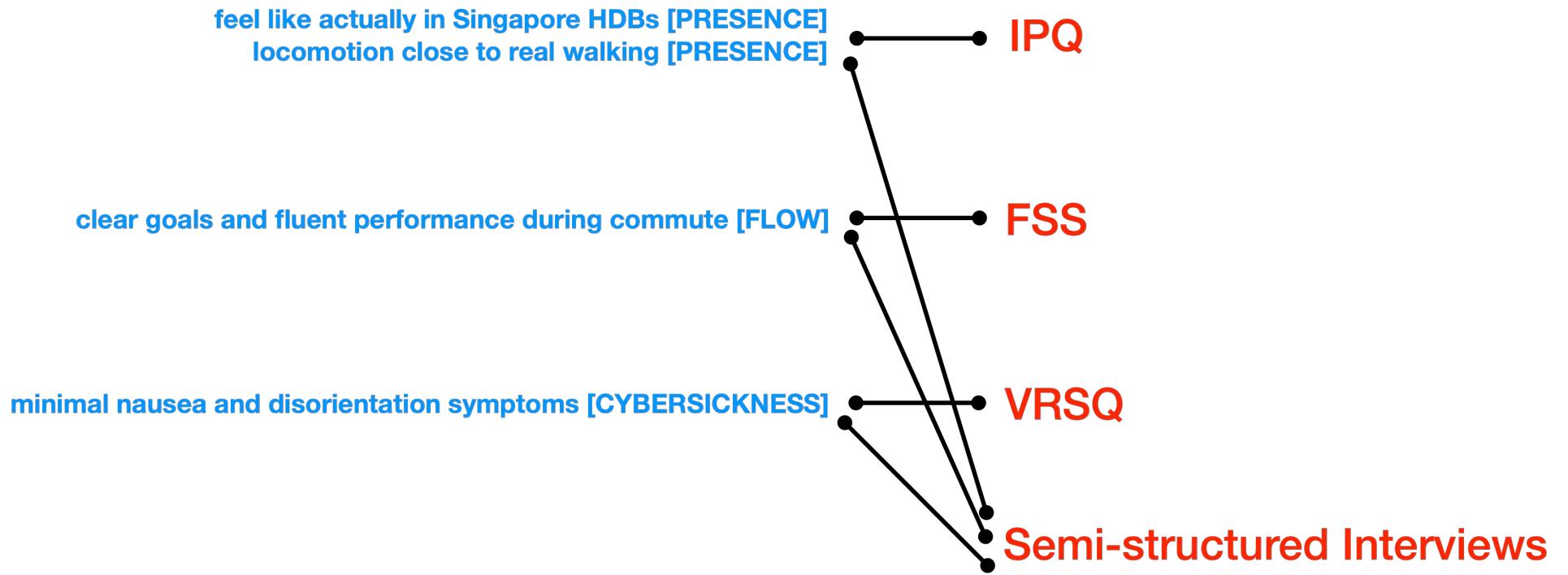
- prototyped various mitigation methods from various prior papers
 - How the Presence and Size of Static Peripheral Blur Affects Cybersickness in Virtual Reality (Lin et. al. 2020)
 - Narrative and gaming experience interact to affect presence and cybersickness in virtual reality (Weech et al. 2020)



Data Collection Appropriate for Experiential Goals

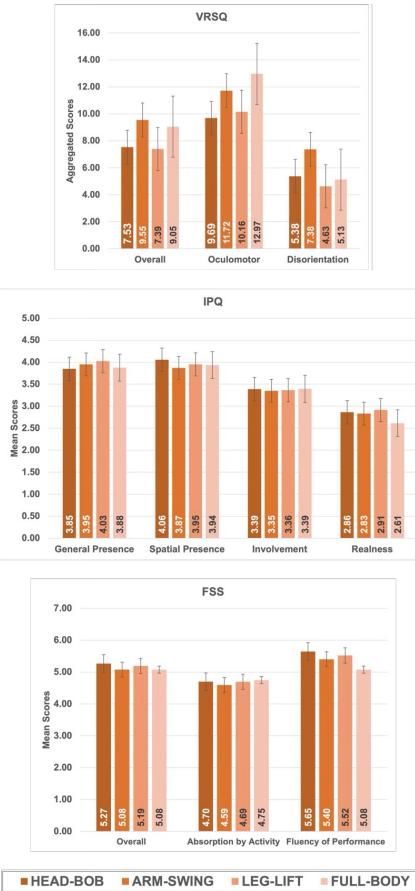


Data Collection Appropriate for Experiential Goals



Analysing Data to Form Conclusions

		CONTEXTUAL CODES					Total across CONTEXTs
		HEAD-BOB	ARM-SWING	LEG-LIFT	FULL-BODY	GENERAL	
Minimal cybersickness with WIP exertion	FATIGUING	8	0	7	7	5	27
	EFFORTLESS	5	8	1	0	1	15
	CYBERSICKNESS	2	7	0	2	1	12
Leg-lift method facilitated most positive experiences	POSITIVE-LOCOMOTION	6	7	25	1	6	45
	NATURAL	4	4	18	1	0	27
	PRESENCE	2	1	6	0	5	14
	EASY-TO-FOCUS	0	2	1	0	1	4
	NEGATIVE-LOCOMOTION	25	23	13	27	21	109
	UNNATURAL	11	14	4	14	3	46
	UNSURE-HOW-TO-LOCOMOTE	6	7	8	6	8	35
	HARD-TO-FOCUS	7	1	0	2	1	11
	DISCOMFORT-EQUIPMENT	0	1	0	1	5	7
	CONSTRAINED-BY-TRACKERS	1	0	0	3	3	7
Varying WIP gestures afforded by tracker positions	CONSCIOUS-OF-APPEARANCE	0	0	1	1	1	3
	AWKWARD-WIP-TECHNIQUE	7	13	5	7	1	33
	ADAPTED-WIP-TECHNIQUE	7	7	5	7	2	28
	AFFORDED-BY-TRACKERS	3	8	5	2	1	19
Perception of control was important for WIP	LACK-SPEED-CONTROL	14	10	17	19	8	68
	LACK-DIRECTION-CONTROL	5	9	10	8	2	34
	LACK-MOMENTUM	1	1	2	4	5	13
Walking-"not"-in-place affects immersion	SPACE-CONSTRAINED	3	4	7	4	5	23
	REQUIRE-SPATIAL-AWARENESS	3	4	2	4	8	21
	UNSAFE	0	0	2	2	7	11
	DISEMBODIMENT	1	0	1	2	2	6
Visual qualities affect WIP motivations	UI-GUIDANCE-WORKS-WELL	0	0	0	0	27	27
	UI-GUIDANCE-CONSTRAINED-EXPLORATION	0	0	0	0	22	22
	INCLINED-TO-EXPLORE	3	2	0	1	15	21
	LACK-OF-MOTIVATION-TO-MOVE	0	0	0	0	8	8
	DESIRE-FOR-MORE-ASSETS	0	0	0	0	45	45
	DESIRE-FOR-MORE-REALISTIC-ASSETS	0	0	0	0	21	21
	DESIRE-FOR-ANIMATED-ASSETS	0	0	0	0	15	15
	DESIRE-FOR-SOUNDS	0	0	0	0	9	9



■ HEAD-BOB ■ ARM-SWING ■ LEG-LIFT ■ FULL-BODY

Experience Dementia in Singapore

Research Case Study 2

Designing for Immersion

It is first essential to consider all stakeholders of the application

- **Users** - the general public
 - gained knowledge to empathize with dementia
 - enhanced experience for someone with an HMD
- **Collaborator** - Dementia Singapore (dementia.org.sg)
 - aims to educate the public on dementia
 - aim for as many users as possible

Having established the context, we craft key design goals for immersion

- improved empathy with dementia (both VR & Desktop) [EFFECTIVENESS]
- minimal physiological discomfort (both VR & Desktop) [CYBERSICKNESS]
- improved immersion in VR over Desktop [PRESENCE]

Design → Implementation

improved empathy with dementia
(both VR & Desktop)
[EFFECTIVENESS]

implement scenarios guided closely by caregiver
domain experts

The screenshot shows the Dementia Singapore website. At the top left is the logo with a brain icon. To the right is the text "DEMENTIA HELPLINE 6377 0700" and a "DONATE NOW" button. Below this is a section titled "Caregiver Support Groups" with a photo of people at a support group meeting. To the left of the photo is a sidebar with text about dementia care services.

Dementia Singapore

DEMENTIA HELPLINE
6377 0700

Caregiver Support Groups

Established dementia care since 1990

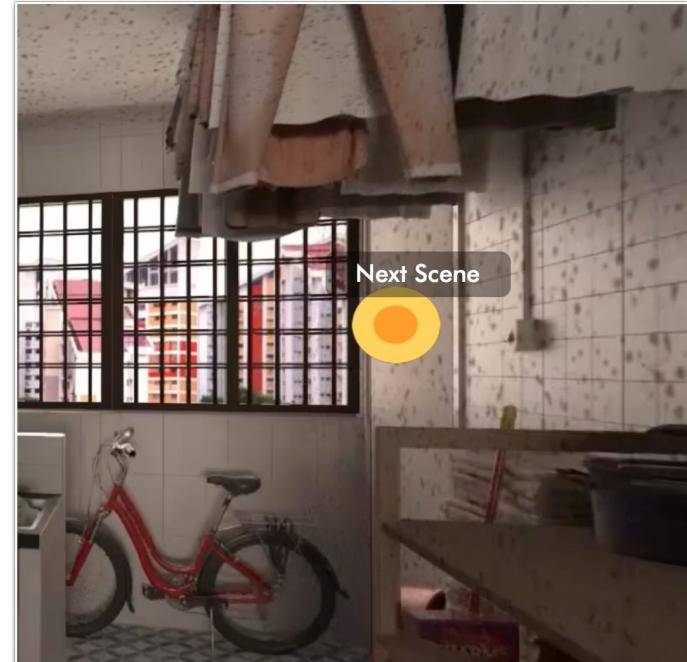
- Dementia Day Care
- Respite
- Dementia Respite Care
- Centres
- Dementia Care
- Short Services
- Training



Design → Implementation

minimal physiological discomfort
(both VR & Desktop)
[CYBERSICKNESS]

use minimal locomotion variability (a point-and-click experience)



Design → Implementation

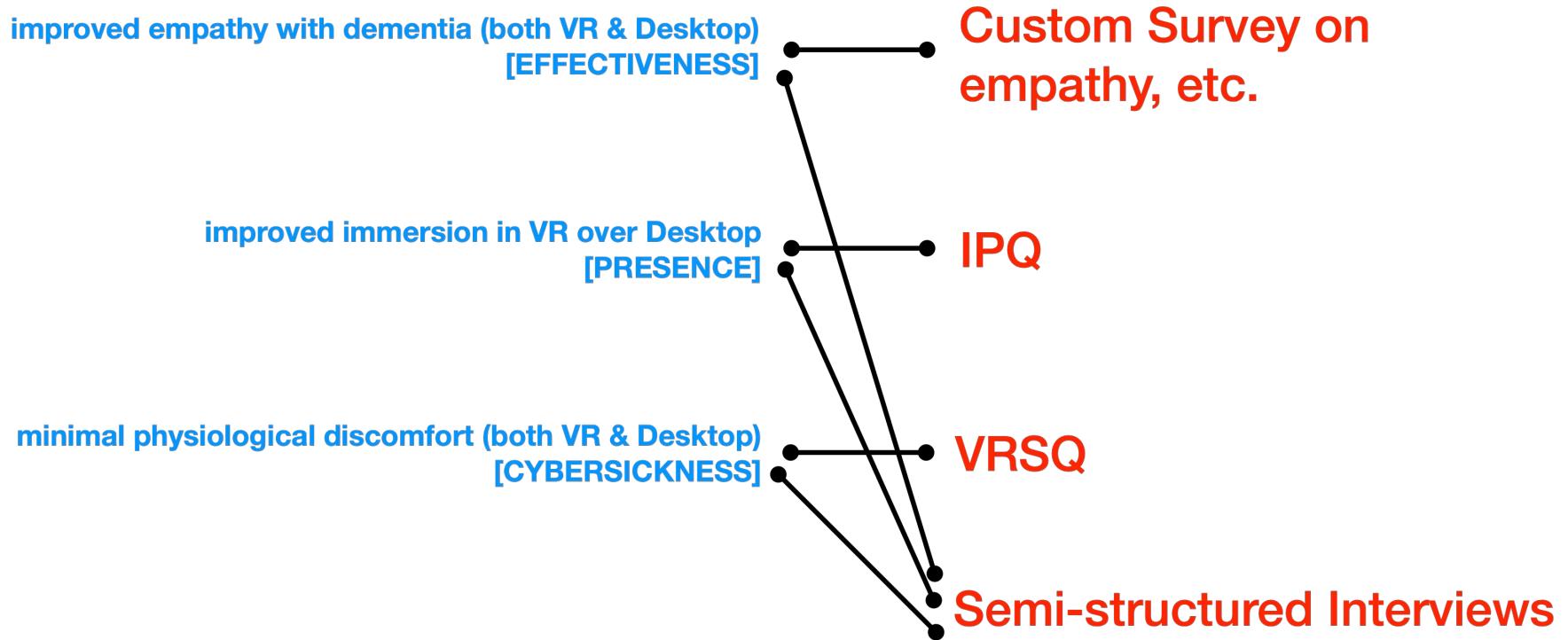
improved immersion in VR over
Desktop [PRESENCE]

provide the most essential VR interaction mechanic -
viewpoint control



<https://dementia.org.sg/2022/03/30/experience-dementia-in-singapore/>

Data Collection Appropriate for Experiential Goals



Analysing Data to Form Conclusions

Median score change in pre/post, Mann-Whitney U Test

Measure	Web-based VR		VR-headset		z score	<i>p</i> (two tailed)	<i>p</i> (one tailed)
	Pre/post median change in score	Obs	Pre/post median change in score	Obs			
Dementia Attitude Scale	11	25	8	57	1.26	.21	.10
Dementia Knowledge and Attitude Scale	3	25	6	57	-3.06	.0022	.0011
Empathy and Understanding in Dementia Index	11	25	10	57	1.04	.30	.85

Mean score for Virtual reality sickness questionnaire (VRSQ), Man-Whitney U Test

Measure	Web-based VR		VR-headset		<i>t</i> score	<i>p</i> (two tailed)
	Mean score	Obs	Mean score	Obs		
Virtual reality sickness questionnaire (VRSQ)	3.03	25	11	27	-3.02	0.0026

Mean score for Igroup Presence Questionnaire (IPQ), and Independent t-test

Measure	Web-based VR		VR-headset		<i>t</i> score	<i>p</i> (two tailed)
	Mean score	Obs	Mean score	Obs		
Igroup Presence Questionnaire (IPQ)	-6.24	25	3.92	27	-3.86	<.001

I got to experience being a person with Dementia and learnt about some troubles I never thought persons with Dementia faced

The audio component of the web based VR made it immersive and helped invoked emotions (eg. heartbeat effect made me feel anxious while humming and the calm music made me feel calm)

I liked the VR experience because I was able to understand and empathize PWDs better in their POV

Study done by SIT Physiotherapy Students 2022

[<https://www.straitstimes.com/life/what-is-it-like-to-have-dementia-experience-it-with-immersive-vr-app>]

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A design goal is to have minimal cybersickness in locomotion given the poor motion tracking fidelity of my phone in the cardboard.

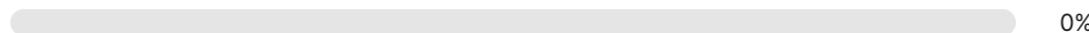
Which of the following implementations will this design translate into?

- ① Start presenting to display the poll results on this slide.

A design goal is to have minimal cybersickness in locomotion given the poor motion tracking fidelity of my phone in the cardboard.

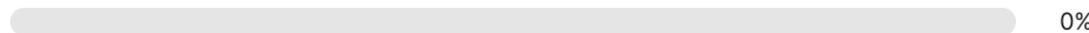
Which of the following implementations will this design translate into?

- Constrict the FOV when moving



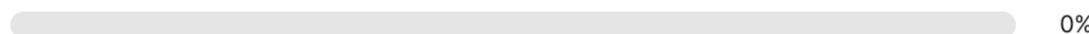
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- Test users using the VRSQ



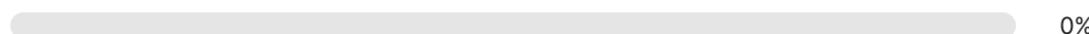
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- Test users using the IPQ



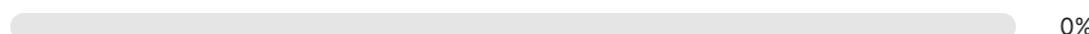
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- Create a walking-in-place locomotion feature



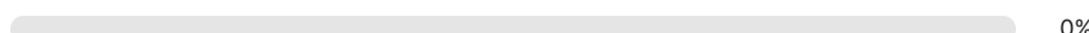
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- Create a teleportation locomotion feature



0%

- Create a high-fidelity realistic 3D environment



0%

Mr. Empathy

04:42



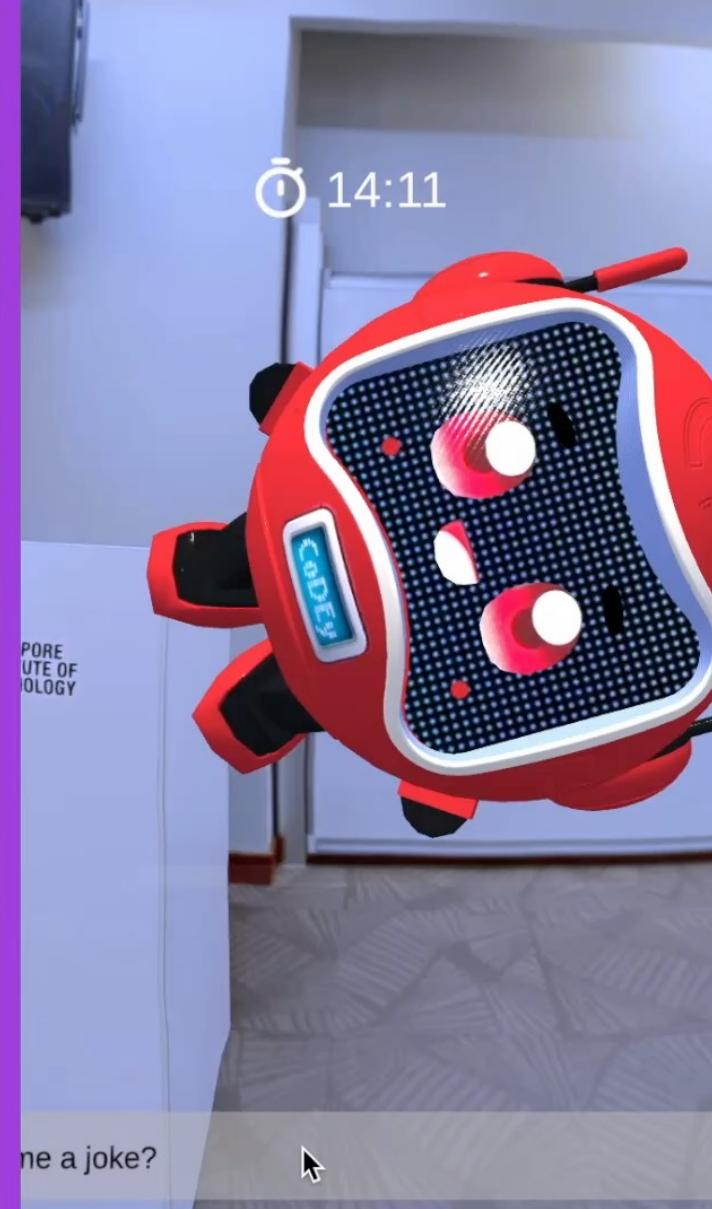
strike a balance in communication. It's important to listen actively to users and allow them to express their thoughts and needs without dominating the conversation. Being chatty can sometimes lead to talking on the wrong topics or not allowing users to fully share their perspectives.

To ensure effective user research, try to be mindful of your communication style. Encourage users to share their thoughts and experiences while also being attentive to their responses. Remember that the goal of user research is to understand users' needs and behaviors, so it's important to create a space where they feel comfortable expressing themselves.

Source

- 2024_Week06_Tutorial03.pdf - on page - [22]
- 2024_Week01_IntroToDesignThinking.pdf - on page - [80]
- 2024_Week02_Tutorial01.pdf - on page - [23]
- 2024_Week05_Define_Downloading_DataStory.pdf - on page - [55]

message...



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A design goal in our VR Tutor app is to create a high sense of plausibility illusion so that it feels like talking to the real lecturer of the module.

Which of the following implementations will this design translate into?

- ① Start presenting to display the poll results on this slide.

A design goal in our VR Tutor app is to create a high sense of plausibility illusion so that it feels like talking to the real lecturer of the module.

Which of the following implementations will this design translate into?

- The AI Tutor embodied by a deepfake of the real human lecturer

0%

- A rule-based response mechanism in the chat feature that has a course-specific answer for all prompts

0%

- Increasingly challenging levels of quizzes posed by the AI Tutor as the student gains knowledge about the content

0%

- Giving full UI control of the AI Tutor avatars facial expressions and limbs

0%

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A design goal is to have minimal cybersickness in locomotion given the poor motion tracking fidelity of my phone in the cardboard.

Which of the following data collection methods will help us evaluate this user experience?

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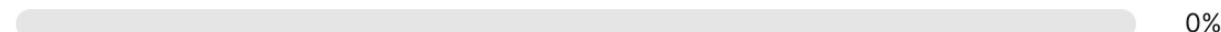
- Test users using the IPQ



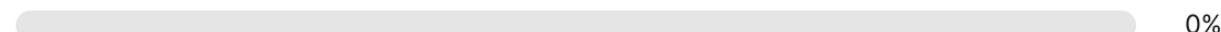
- Test users using the FSS



- Let users fill in the VRSQ



- Perform semi-structured interviews with users



- Create telemetry tracking mechanisms to observe users



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A design goal in our VR Space Simulator is for users to feel like they are actually "there" in the space shuttle out in space (yes the zero-gravity kind).

Which of the following implementations will this design translate into?

- ① Start presenting to display the poll results on this slide.

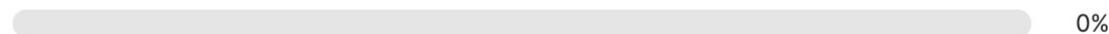
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- Constrict the FOV when moving



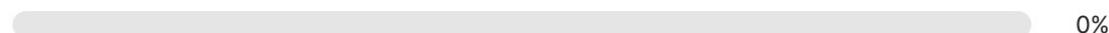
- Test users using the FSS



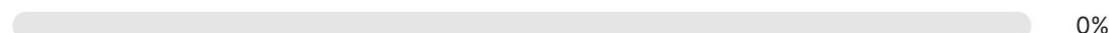
- Test users using the IPQ



- Create a zero-gravity arena that simulates physical weightlessness



- Create gamification features to guide users through the experience



- Create a high-fidelity realistic 3D environment



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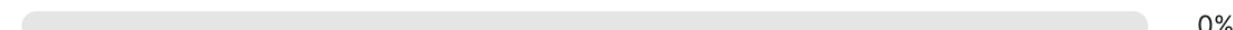
- Test users using the IPQ



- Test users using the FSS



- Let users fill in the VRSQ



- Perform semi-structured interviews with users



- Create telemetry tracking mechanisms to observe users



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A design goal is for users in our VR museum gallery app to be fully absorbed in a smooth engaging experience in which they naturally know what to do in each step of the experience.

Which of the following implementations will this design translate into?

- ① Start presenting to display the poll results on this slide.

A design goal is for users in our VR museum gallery app to be fully absorbed in a smooth engaging experience in which they naturally know what to do in each step of the experience.

Which of the following implementations will this design translate into?

- Create finger-tracked hand gestures to inspect museum artifacts



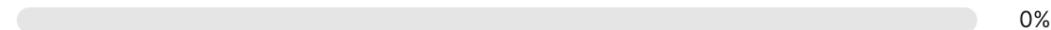
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- Test users using the FSS



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- Provide clear audio and haptic feedback when user interacts with the museum artifacts



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- Create a teleportation locomotion feature



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- Create gamification features to guide users through the experience



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- Create high-fidelity realistic 3D museum artifacts



0%

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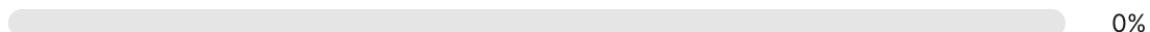
Which data collection methods will help us evaluate this user experience?

Test users using the IPQ



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Test users using the FSS



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Let users fill in the VRSQ



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Perform semi-structured interviews with users



0%

Create telemetry tracking mechanisms to observe users



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The Slido logo, featuring the word "slido" in a lowercase, bold, sans-serif font.

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Audience Q&A

- ① Start presenting to display the audience questions on this slide.