A Human-Computer Interaction Study On Decision-Making Performance in a Digital Twin Building Program for Different Types of Virtual Displays

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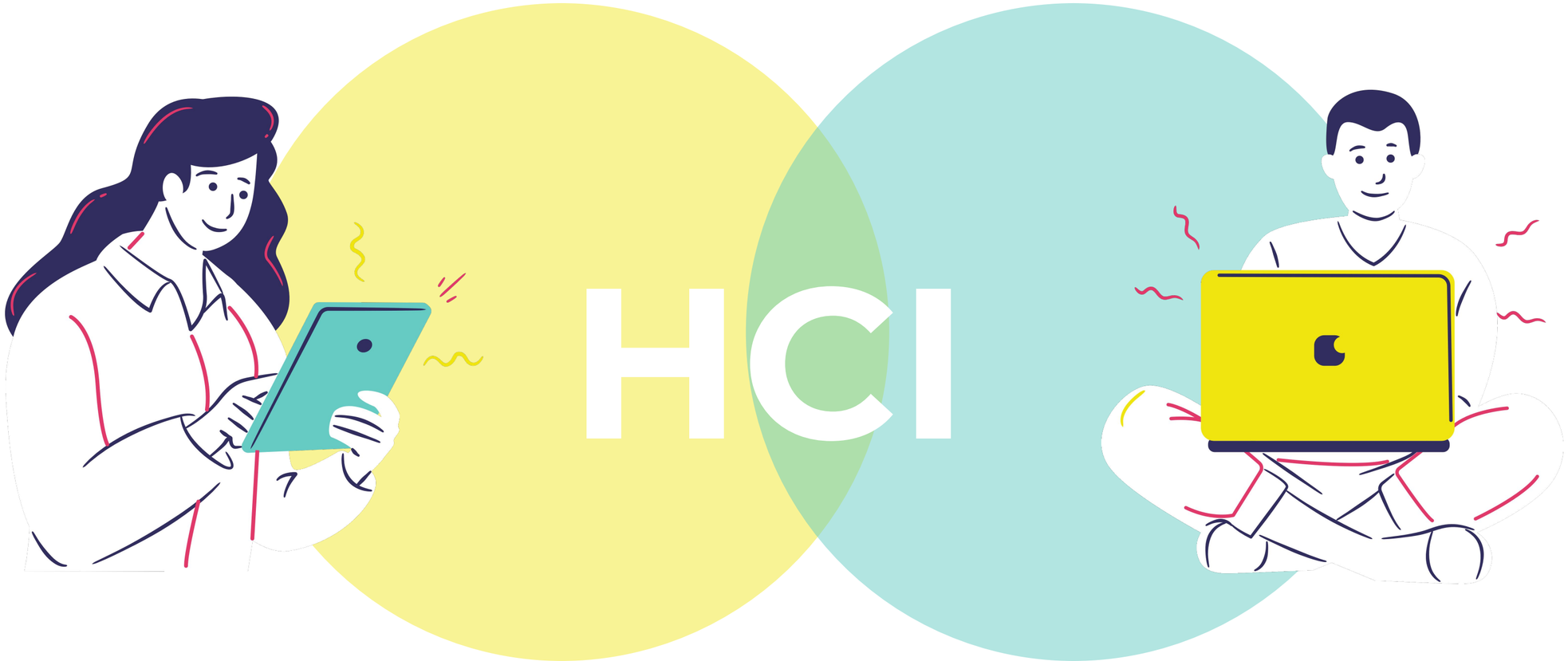
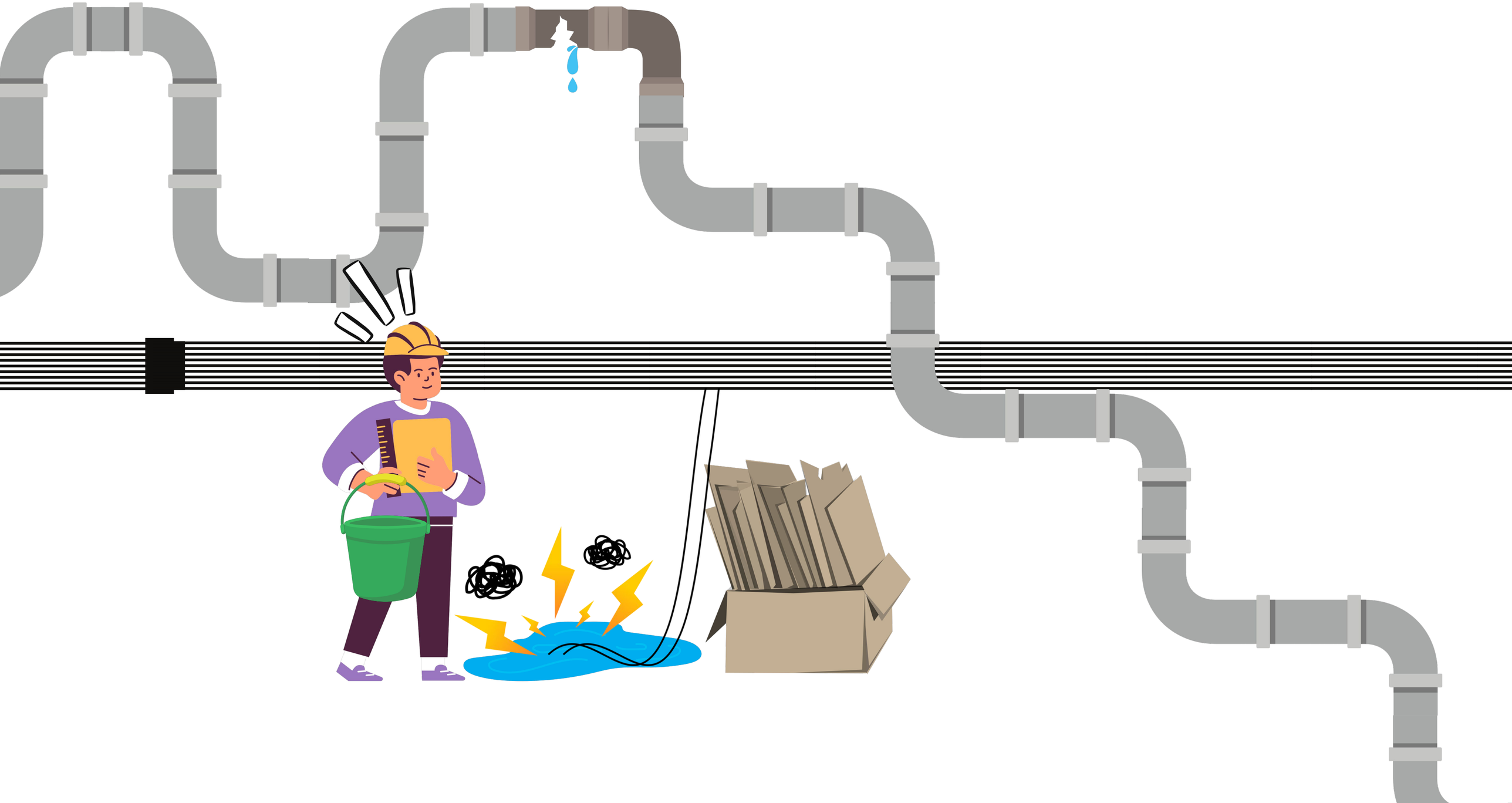
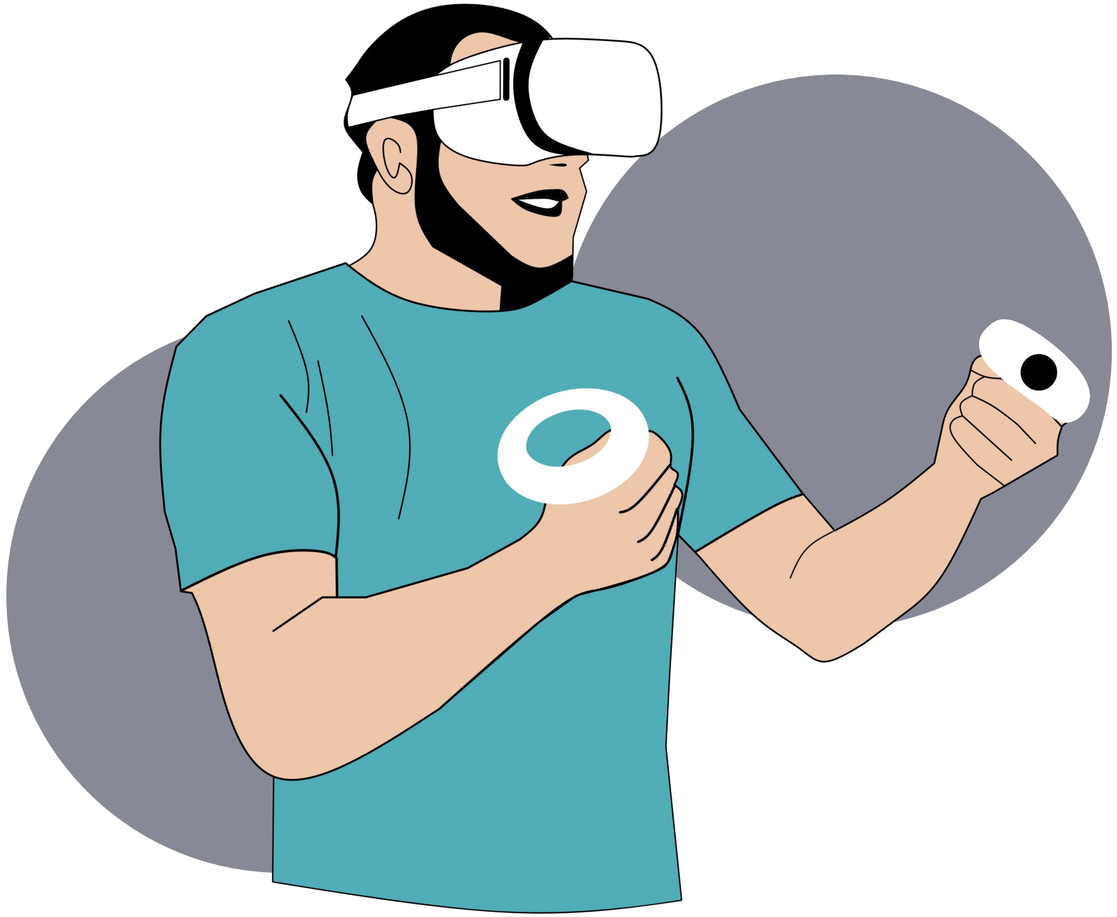

HCI



Hypothesis

The head-mounted display can simulate an experience similar to the actual work.

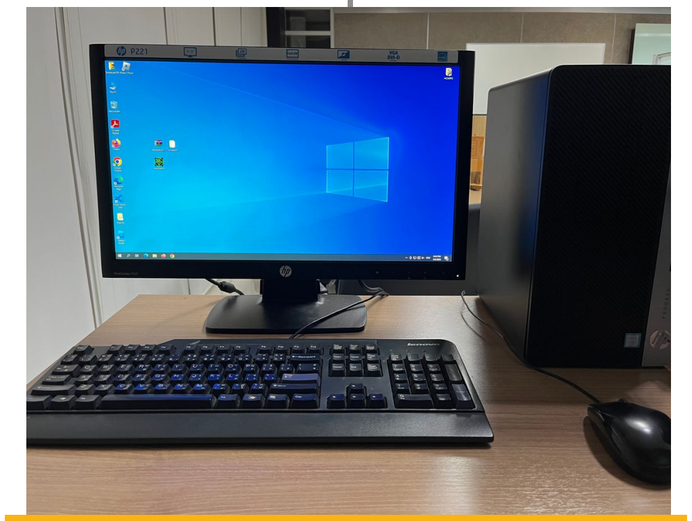
The head-mounted will take less time to evaluate the problems.



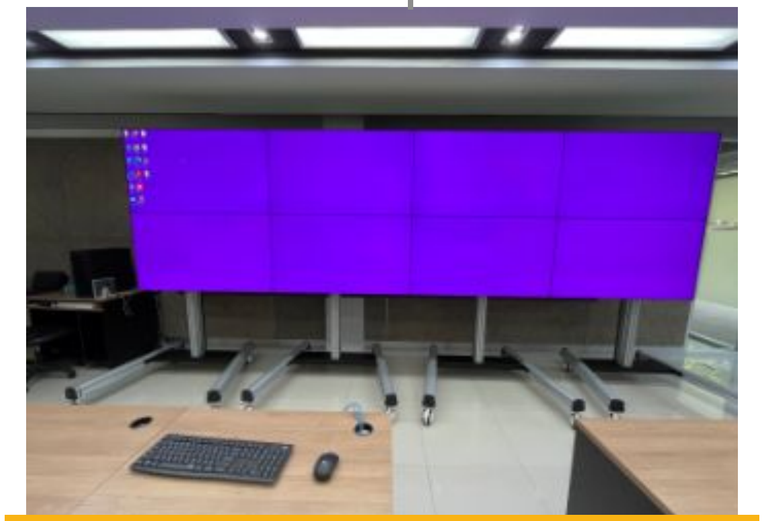
Design

Independent variable & Dependent variable

Types of display screens



Computer Screens



Multi-Monitors

Head-mounted Displays (VR)

Design

Control variable

01: Train

Training before starting the experiment

02: Task

Creating a similar task

03: Refresh Rate(Hz)

Control the display to be the same

04: Cost

Ignore the cost of display

Design

Software development

Design

Key factors for task design

01: Observational tasks

Similar to the real work.

02: Virtual Environment

Resemble the real world.

03: Analysis

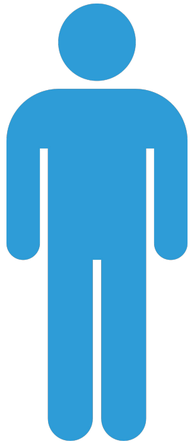
An analysis is required to get the answer.

Participants

Bachelor's degree
2

Master's degree
4

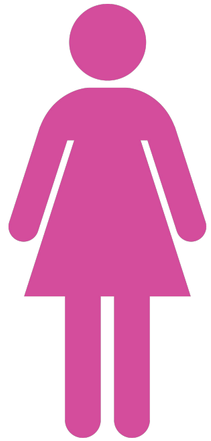
6 person



Total number of participants
12 person

Age
20 - 40 years

6 person



Bachelor's degree
4

Master's degree
2

Procedure

Define task

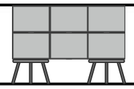
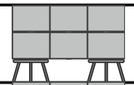
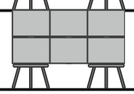
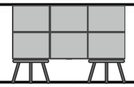
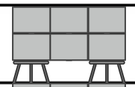
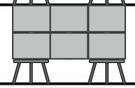
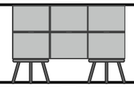
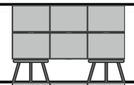
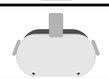
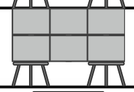
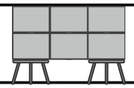
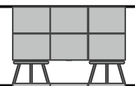
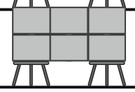
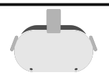
01: Water Leak

02: High Temperature

03: Measure Object

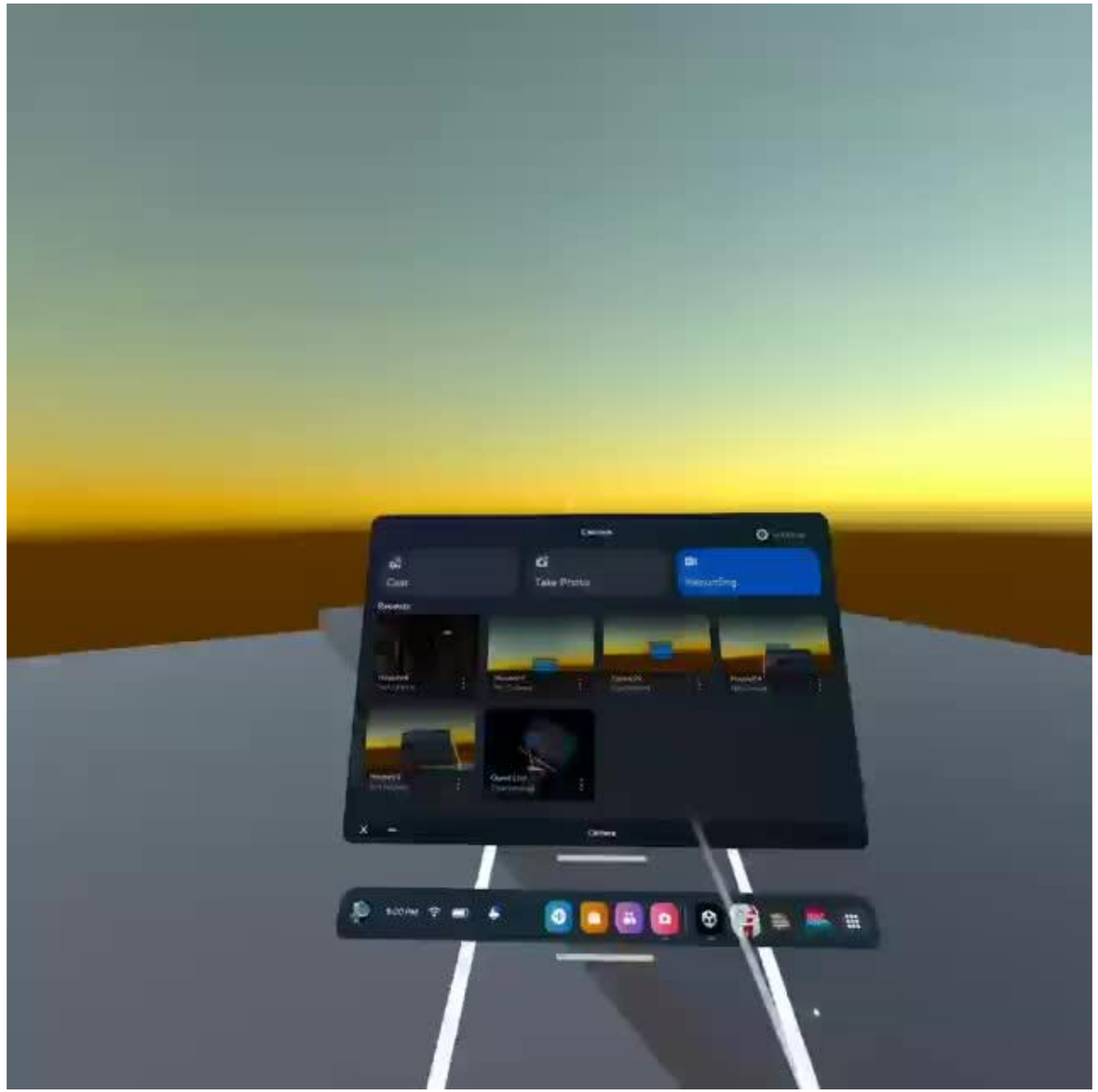
Procedure

Design by Latin Square

Participant no.	Round 1	Round 2	Round 3
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			

Procedure

Training



Video training: https://drive.google.com/file/d/1Cub8-WSbPuakxY92yp62Pp1BYvNu9jhs/view?usp=share

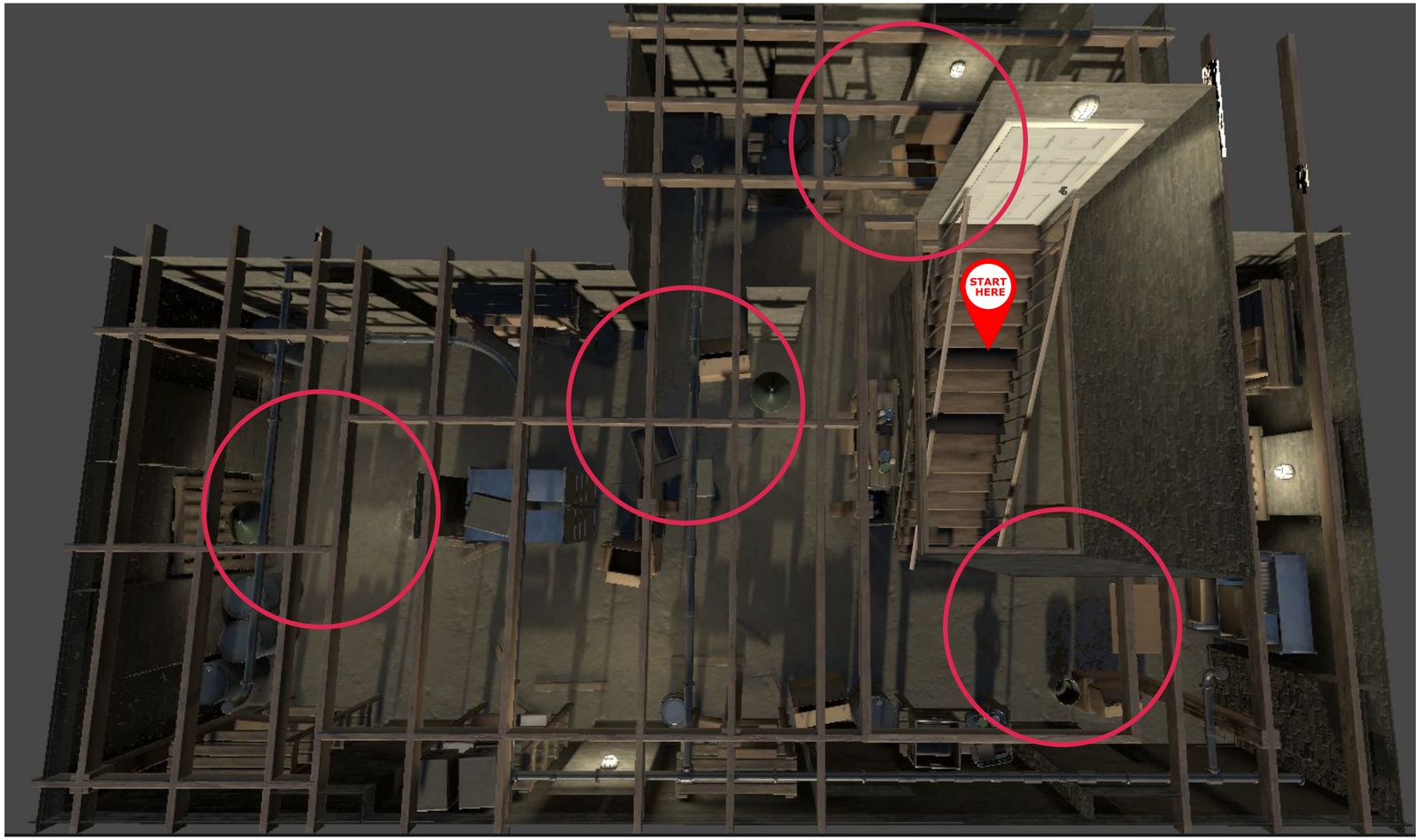
Procedure

Task: Water Leak

Video demo: https://drive.google.com/file/d/1h17vMmYFw3a4YP52SJjwtLXbA5jVaPEA/view?usp=share

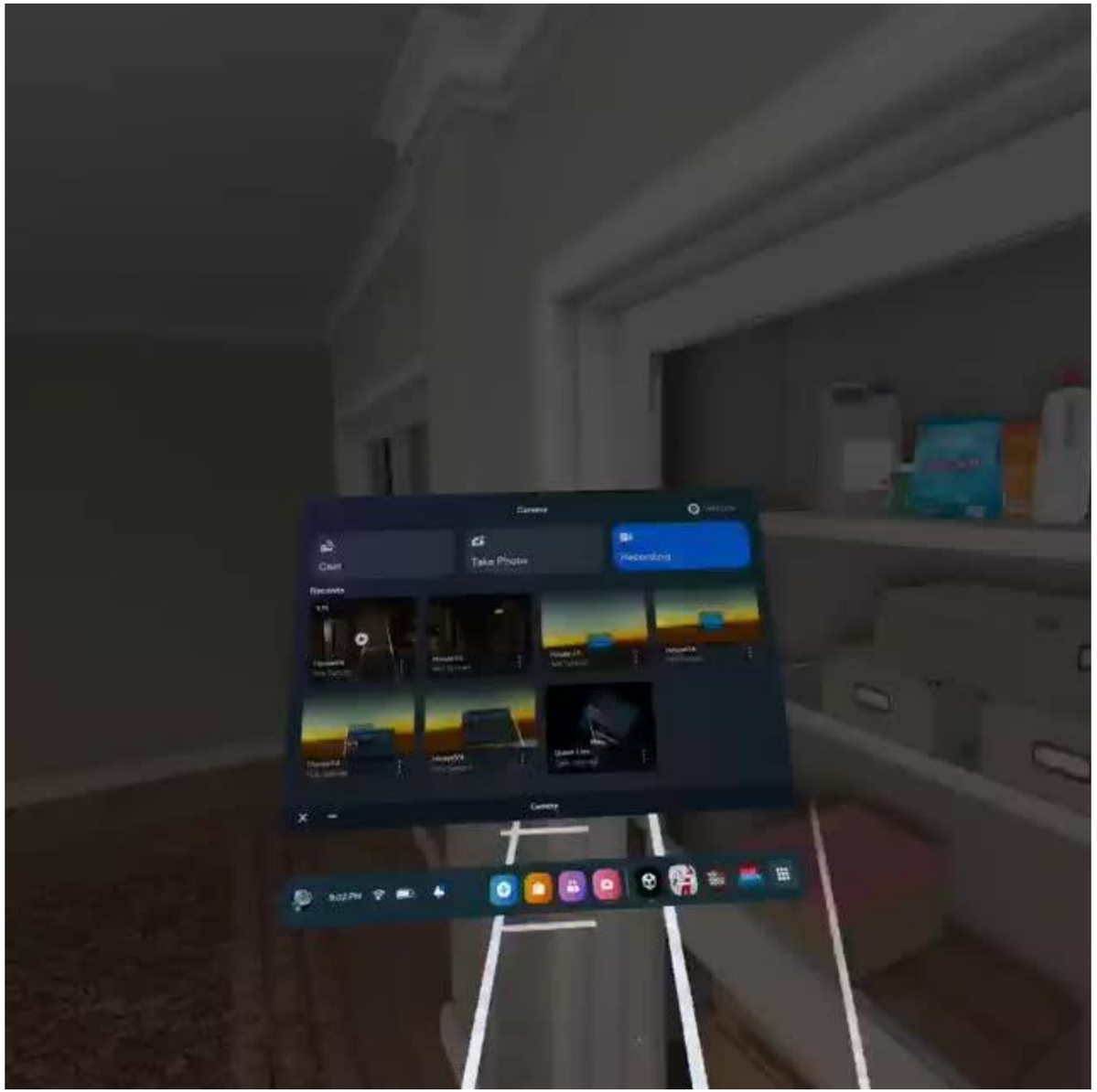
Procedure

Task: Water Leak



Procedure

Task: High Temperature



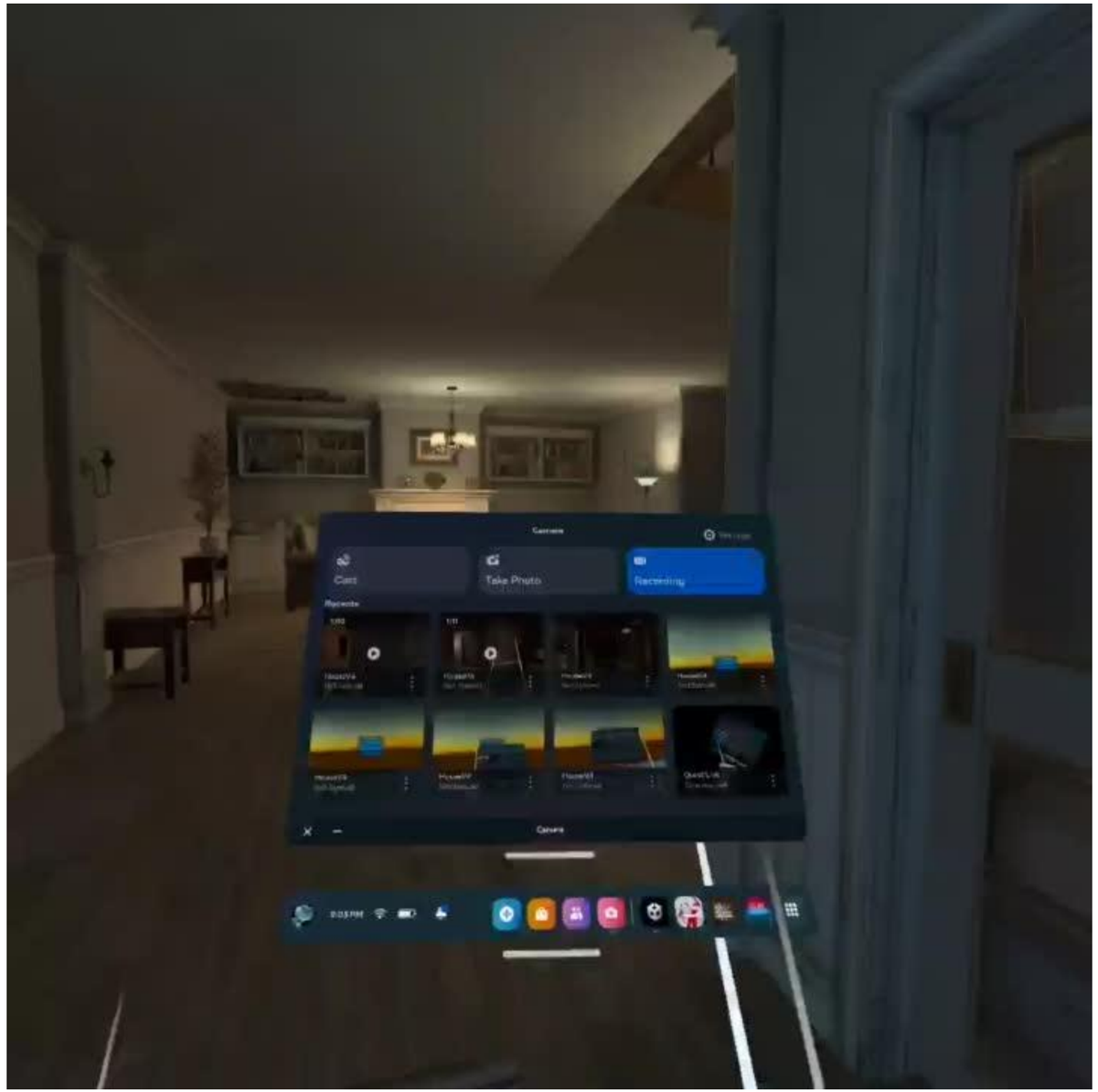
Video demo: https://drive.google.com/file/d/164Tgz7q71vs-MHvSswXk-QKAKlrwT8EV/view?usp=share

Procedure

Task: High Temperature

Procedure

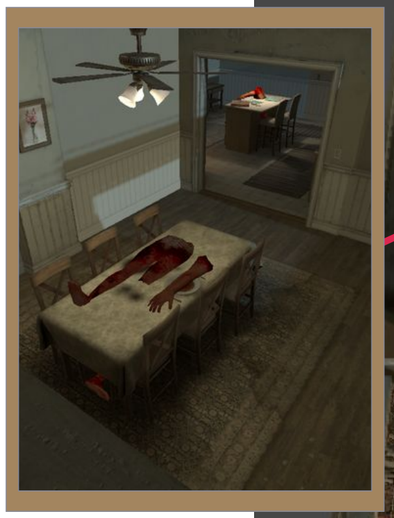
Task: Measure object

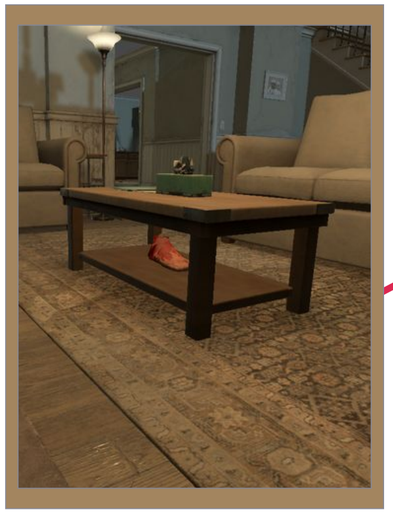


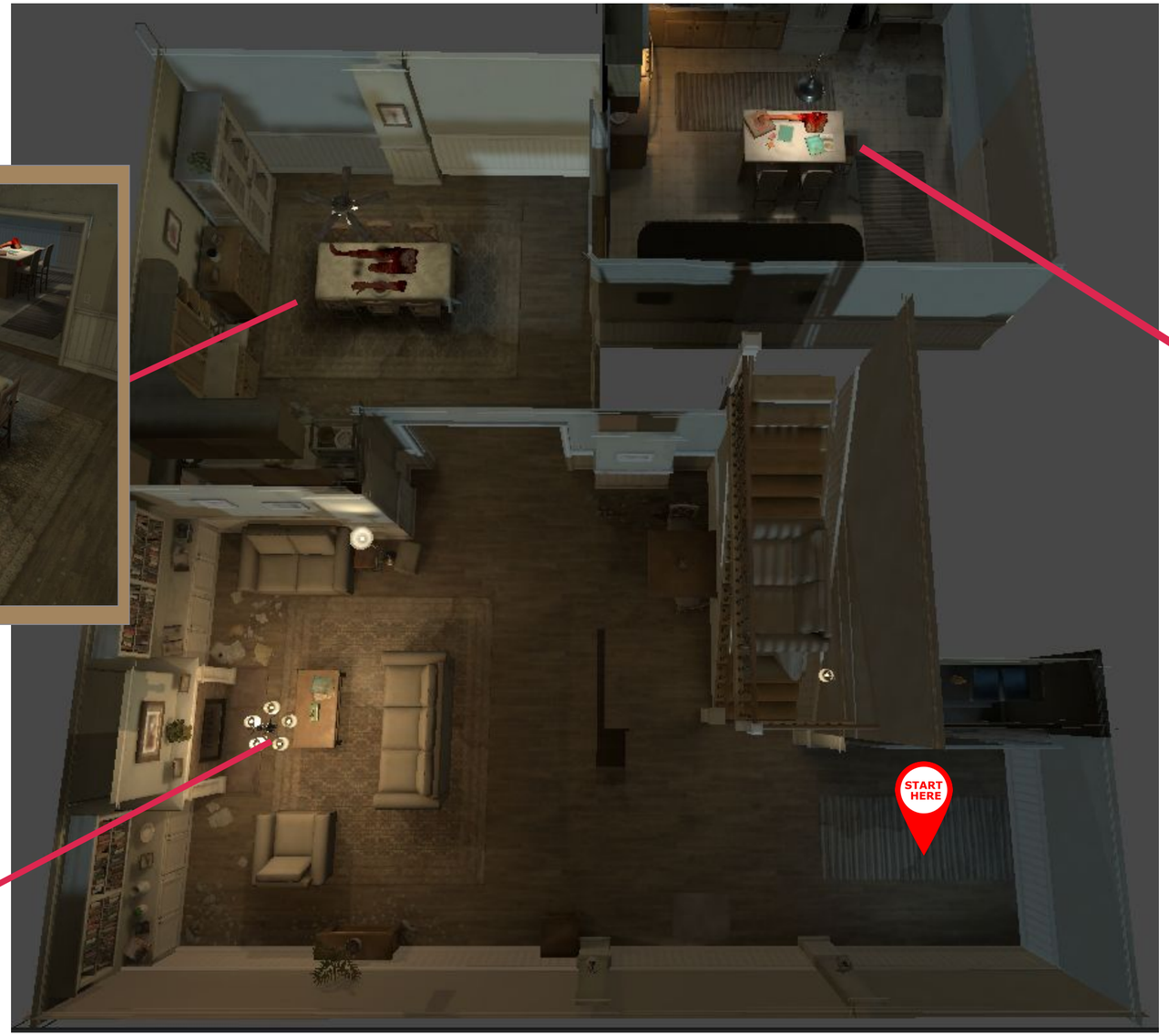
Video demo: https://drive.google.com/file/d/1L4LhoGGP1iHnoer1ajE86_y9L_rNKYt1/view?usp=share

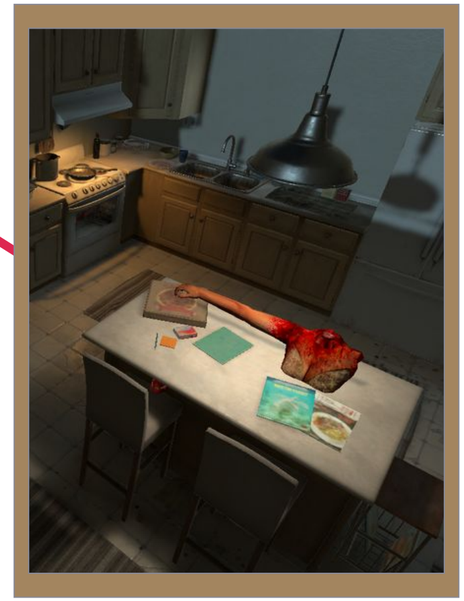
Procedure

Task: Measure object



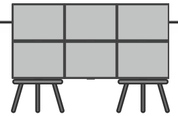
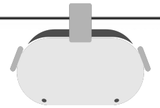




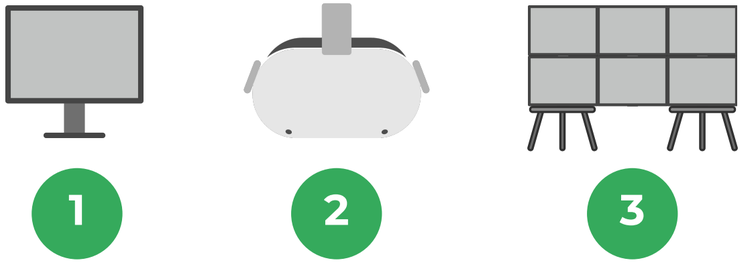


Result

Raw data collected from experiments

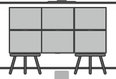
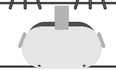
Participant no.	 (seconds)	 (seconds)	 (seconds)
1.	191.43	216.59	152.04
2.	495.10	376.18	350.63
3.	161.56	157.54	258.56
4.	106.94	92.72	294.01
5.	152.40	197.23	195.34
6.	199.85	365.37	216.78
7.	238.17	402.81	288.50
8.	262.52	282.91	307.99
9.	171.25	144.45	172.88
10.	81.41	117.70	172.96
11.	112.77	167.95	164.30
12.	92.85	150.34	175.46

The most common form of results



Result

Descriptive Statistics

	Mean	SD	N
	188.85	111.77	12
	222.65	107.53	12
	229.12	67.57	12

Mauchly's Test of Sphericity

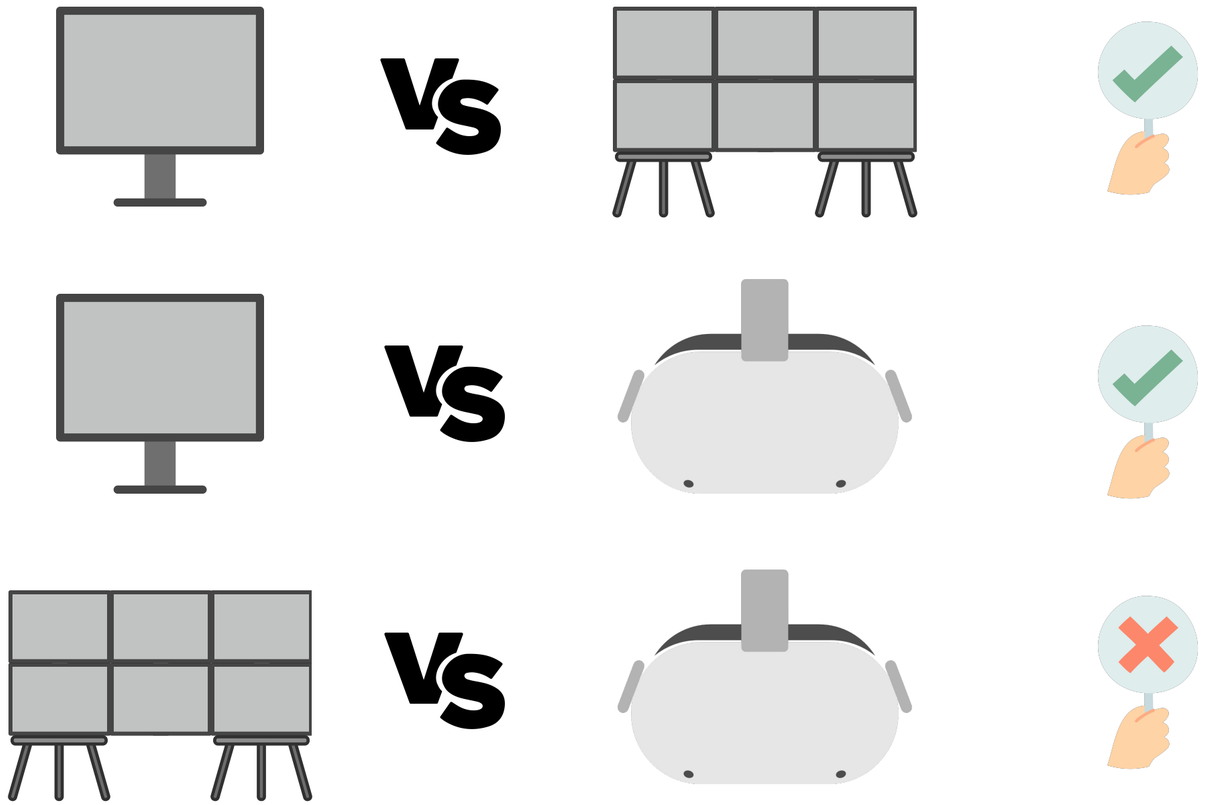
Within Subject Effect	Mauchly's W	df	Sig.
display	0.949	2	0.769

Test of Within-Subject Effects

Source	df	F	Sig.
Display Sphericity Assumed	2	1.583	0.228
Error Display Sphericity Assumed	22		

Result

Comparing Different Types of Display Screens: Bonferroni



Result

Descriptive Statistics

Dependent Variable: Seconds

Display	Mean	Std. Deviation	N
Normal	296.8050	135.44780	4
Large	220.2225	98.67865	4
VR	224.6025	61.40759	4
Total	247.2100	100.16340	12

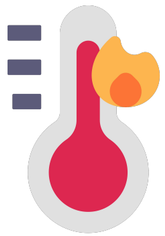
Water Leak

Descriptive Statistics

Dependent Variable: Seconds

Display	Mean	Std. Deviation	N
Normal	156.3775	45.36390	4
Large	207.4550	140.79193	4
VR	254.5650	88.95333	4
Total	206.1325	99.39403	12

High Temperature



Descriptive Statistics

Dependent Variable: Seconds

Display	Mean	Std. Deviation	N
Normal	113.3800	29.36260	4
Large	240.2700	110.02337	4
VR	208.1950	59.85415	4
Total	187.2817	87.63344	12

Measure Object

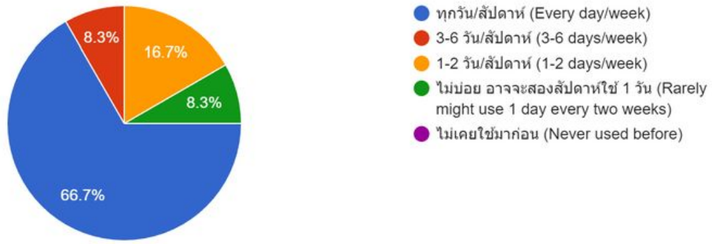
Result

Survey

ก่อนเข้าร่วมการทดลอง ใช้จอขนาดปกติทั่วไป (ขนาดประมาณในรูป) บ่อยแค่ไหน
Before participating in the experiment, how often do you use a standard size screen (approximately the size in the picture)?

Copy

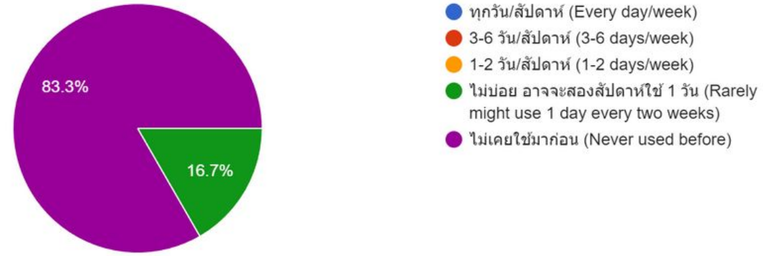
12 responses



ก่อนเข้าร่วมการทดลอง ใช้ Virtual Reality (VR) บ่อยแค่ไหน
Before participating in the experiment, how often do you use a Virtual Reality (VR)?

Copy

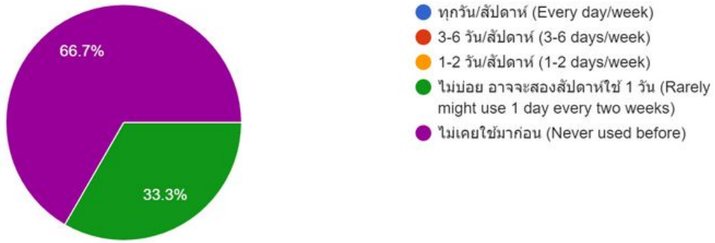
12 responses



ก่อนเข้าร่วมการทดลอง ใช้จอขนาดใหญ่ (ขนาดประมาณในรูป) บ่อยแค่ไหน
Before participating in the experiment, how often do you use a large screen (approximately the size in the picture)?

Copy

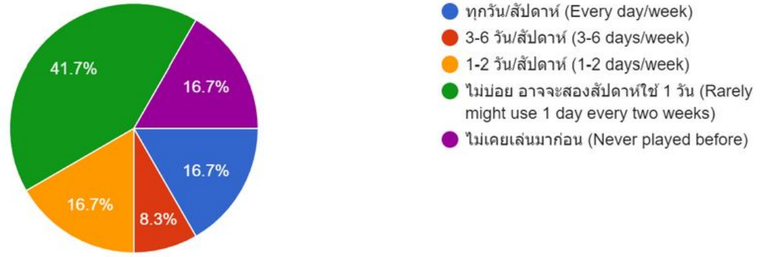
12 responses



เคยเล่นเกมแนว First Person หรือไม่ ถ้าเคยบ่อยแค่ไหน
Have you ever played First Person games? If so, how often?

Copy

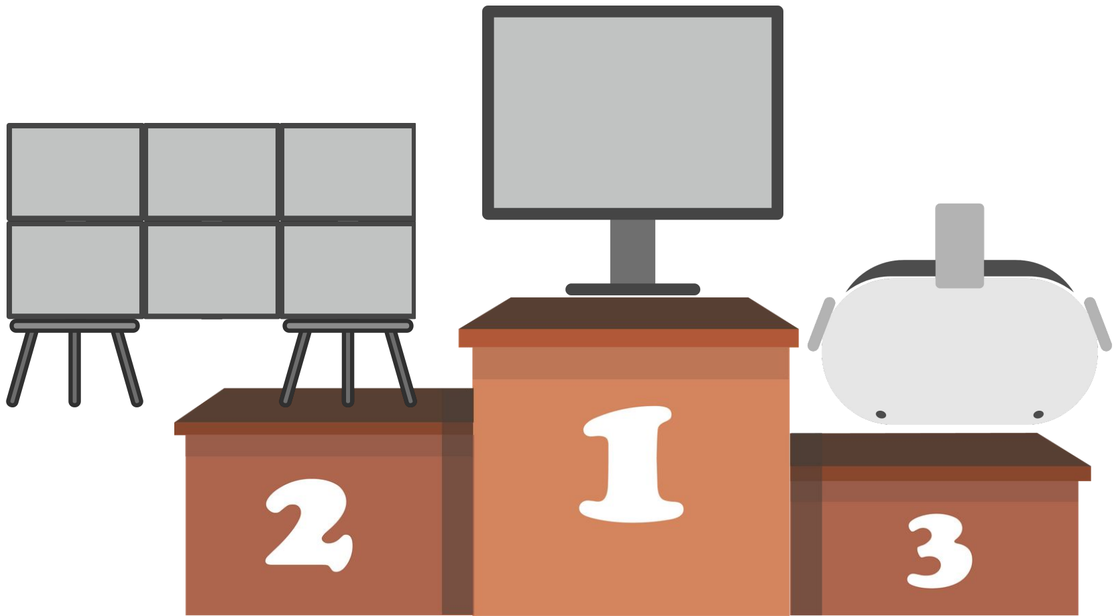
12 responses



Discussion & Conclusion

Future Works

- Assessment mistakes.
- Set time separately according to criteria.
- More Diversity of testers and include potential testers.



THANK YOU

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Variable View

Name	Type	Width	Decimals	Label	Values	Missing	Columns	Align	Measure	Role
disNormal	Numeric	8	2	computer display	None	None	8	Right	Scale	Input
disLarge	Numeric	8	2	Large display	None	None	8	Right	Scale	Input
disHead	Numeric	8	2	HMDs display	None	None	8	Right	Scale	Input

Data View

disNormal	disLarge	disHead
191.43	216.59	152.04
495.10	376.18	350.63
161.56	157.54	258.56
106.94	92.72	294.01
152.40	197.23	195.34
199.85	365.37	216.78
238.17	402.81	288.50
262.52	282.91	307.99
171.25	144.45	172.88
81.41	117.70	172.96
112.77	167.95	164.30
92.85	150.34	175.46

Pairwise Comparisons

Measure: MEASURE_1

(I) factor1	(J) factor1	Mean Difference (I-J)	Std. Error	Sig.[a]	95% Confidence Interval for Difference[a]	
					Lower Bound	Upper Bound
1	2	-33.795	22.462	.482	-97.140	29.550
	3	-40.267	23.349	.338	-106.113	25.579
2	1	33.795	22.462	.482	-29.550	97.140
	3	-6.472	26.873	1.000	-82.254	69.311
3	1	40.267	23.349	.338	-25.579	106.113
	2	6.472	26.873	1.000	-69.311	82.254

Based on estimated marginal means

a. Adjustment for multiple comparisons: Bonferroni.

Video introduction: https://drive.google.com/file/d/1Cub8-WSbPuakxY92yp62Pp1BYvNu9jhs/view?usp=share

Design

Key Factors for Task Design

01: Observational tasks

Similar to the real work.

02: Virtual Environment

Resemble the real world.

03: Analysis

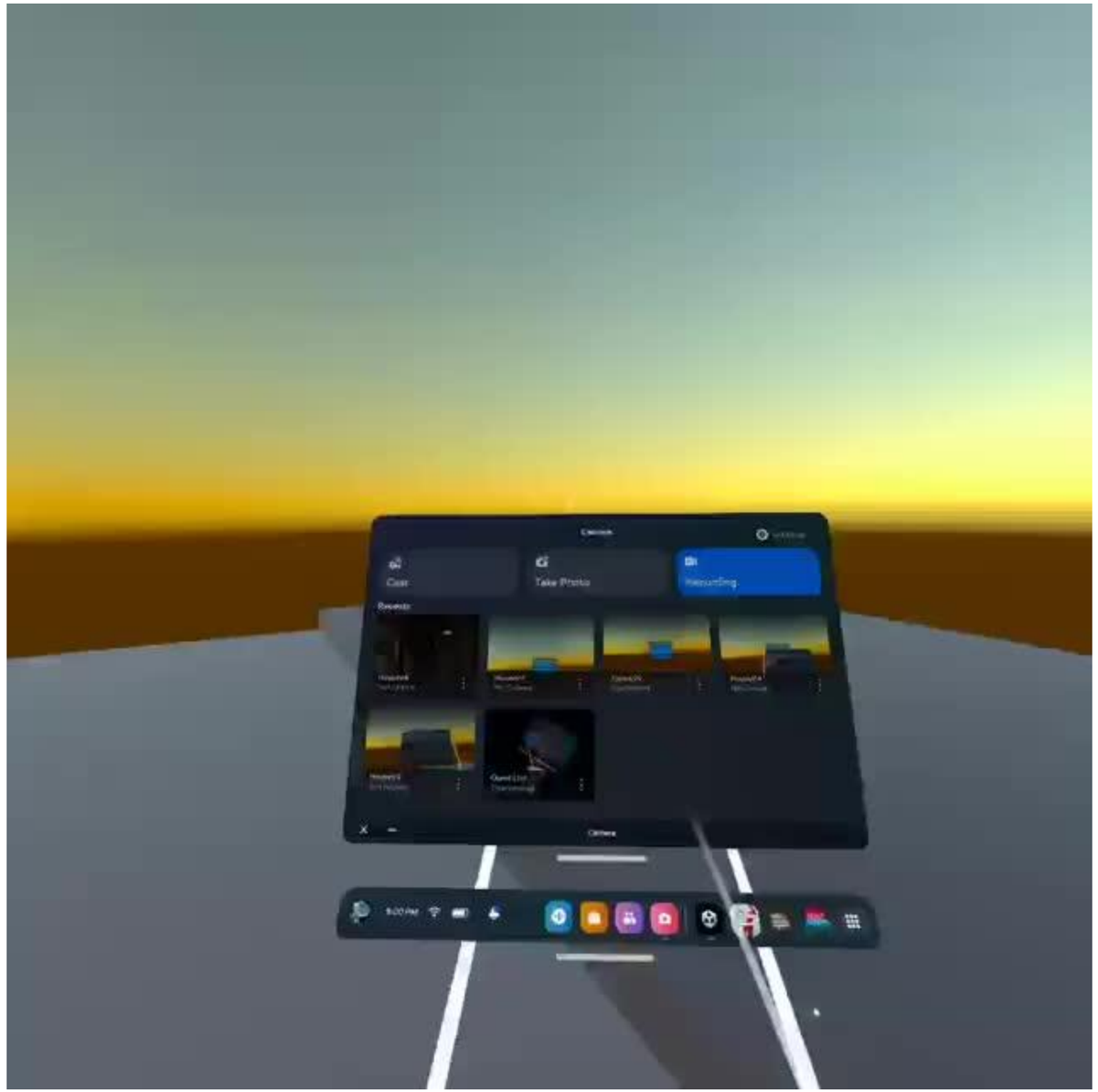
An analysis is required to get the answer.

04: Time and Safety

The system must have the ability to reduce time. and create safety for users

Procedure

Training



Video training: https://drive.google.com/file/d/1Cub8-WSbPuakxY92yp62Pp1BYvNu9jhs/view?usp=share

Discussion & Conclusion