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Investigating Eye-Tracking in 3rd Party Off-the-Shelve VR Software

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Outline

- Background & Motivation
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- Conclusion

Hochschule Anhalt, Köthen-Germany

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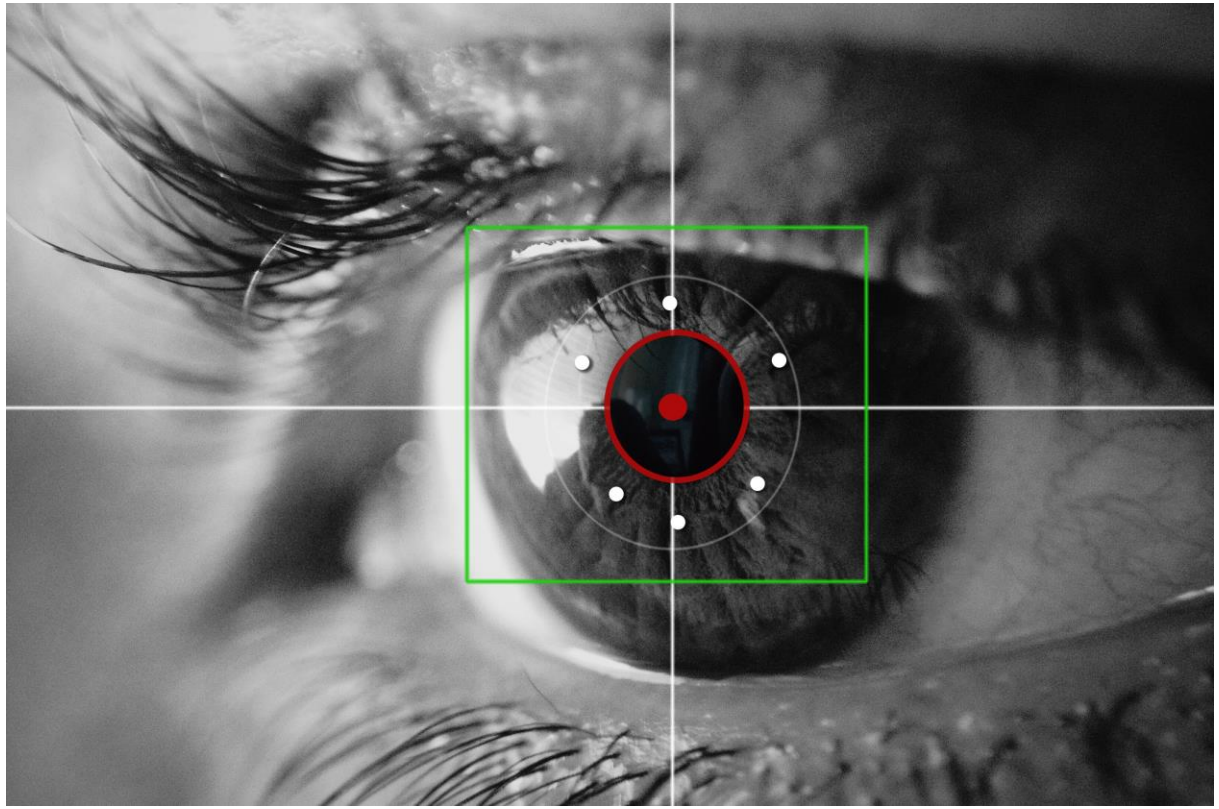
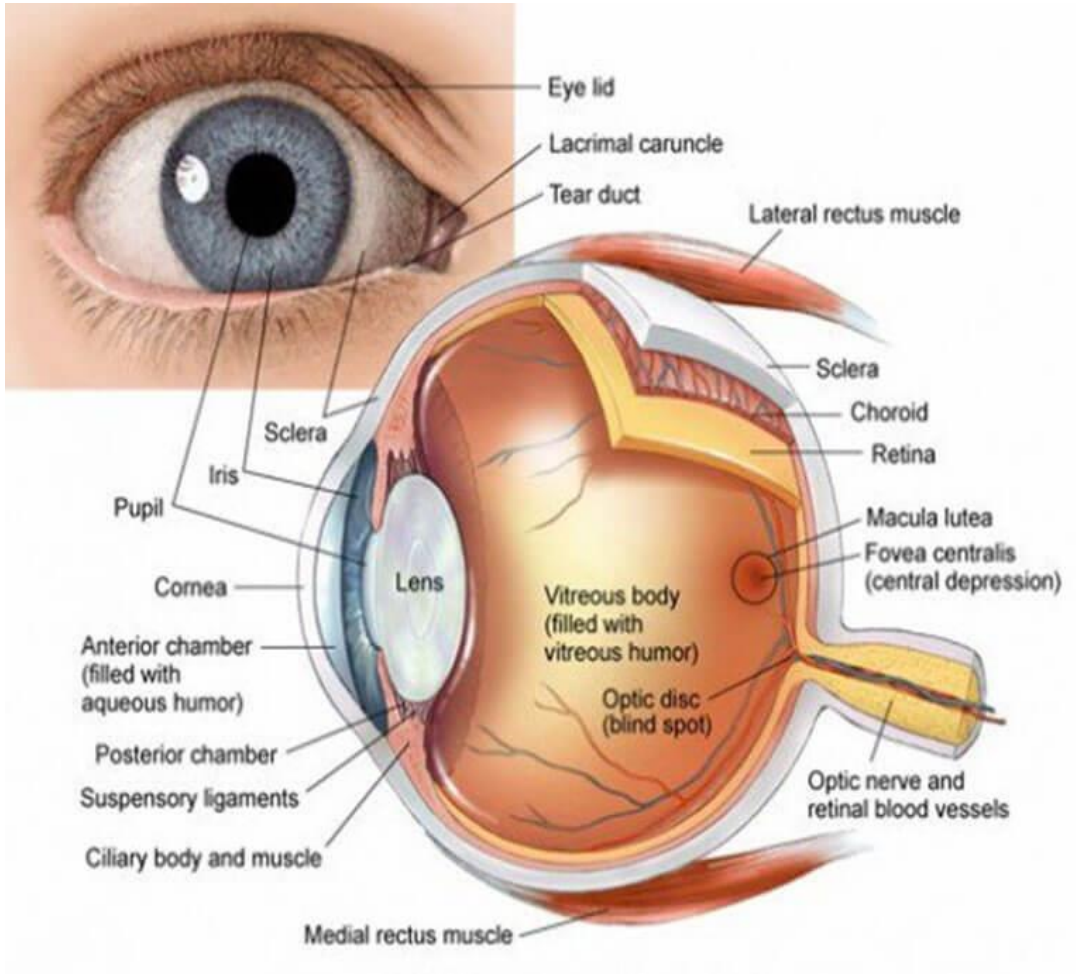
Background & Motivation



Eye -Tracking



Schematic view of the human eye

State of the Art – Eye-Tracking in VR

1. Wei Liu et al, 2017: “Visual attention-based evaluation for multiple-choice tests in e-learning applications,”: a measure of the eye movement data of a group of 40 students in an online multiple-choice test.

Result: The fixation duration and the gaze sequence on each AOI showed specifically, the difference in gaze movement of each participant.

2. Maresky, H.S. *et al* 2019: Virtual reality and cardiac anatomy: exploring immersive three-dimensional cardiac imaging, a pilot study in undergraduate medical anatomy education.

- 2 groups: VR - Customized Cardiac VR Platform (Designed)

  Non-VR group – Cadeveric Dissection

Results : VR is a fun and effective tool for teaching normal cardiac anatomy.

3. Odame. A, 2021: VR as a teaching tool in Medical Education: investigating VR as an effective tool for cardiac anatomy education.

- 2 groups : VR – Predesigned VR software

  Non-VR group – PowerPoint Presentation

Result: VR was as effective as the traditional PowerPoint presentation in teaching cardiac anatomy

Aim:

- The aim of this study is to find ways to determine the correlation between visual attention and learning outcome in an immersive cardiac anatomy education using an eye tracking VR head mounted display with off the shelve software.

MOTIVATION

- Eye tracking can provide reliable quantitative data. For Biomedical Engineering, it can help to give insight into cognitive/natural behaviour.
- Provide a high level of details for the design, development, and testing of devices for clinical researches, that can help in education, monitoring, management, support and replacement of vital body parts or devices. As in our case, the heart.

Research Questions

- **RQ1**: Is it possible to record eye-tracking data from off-the-shelve software without implementation of specific eye-tracking SDKs?
- **RQ2**: Is it possible to see gaze replays and determine the participants fixation from the eye-tracking data?
- **RQ3**: From the analysis of eye-tracking data, is it possible to forecast the user's learning performance?

Use Case and Implementation

Participants

- 20 students
- Mainly from biomedical engineering graduate program of Anhalt University.

Procedures

- Study the heart via eye tracking device.
- Perform a quiz about the heart.

Method

- Varjo VR-2 head mounted display
- Predesigned VR software from Steam.
- Python, Spss, Microsoft Excel.

Experimental Study Design

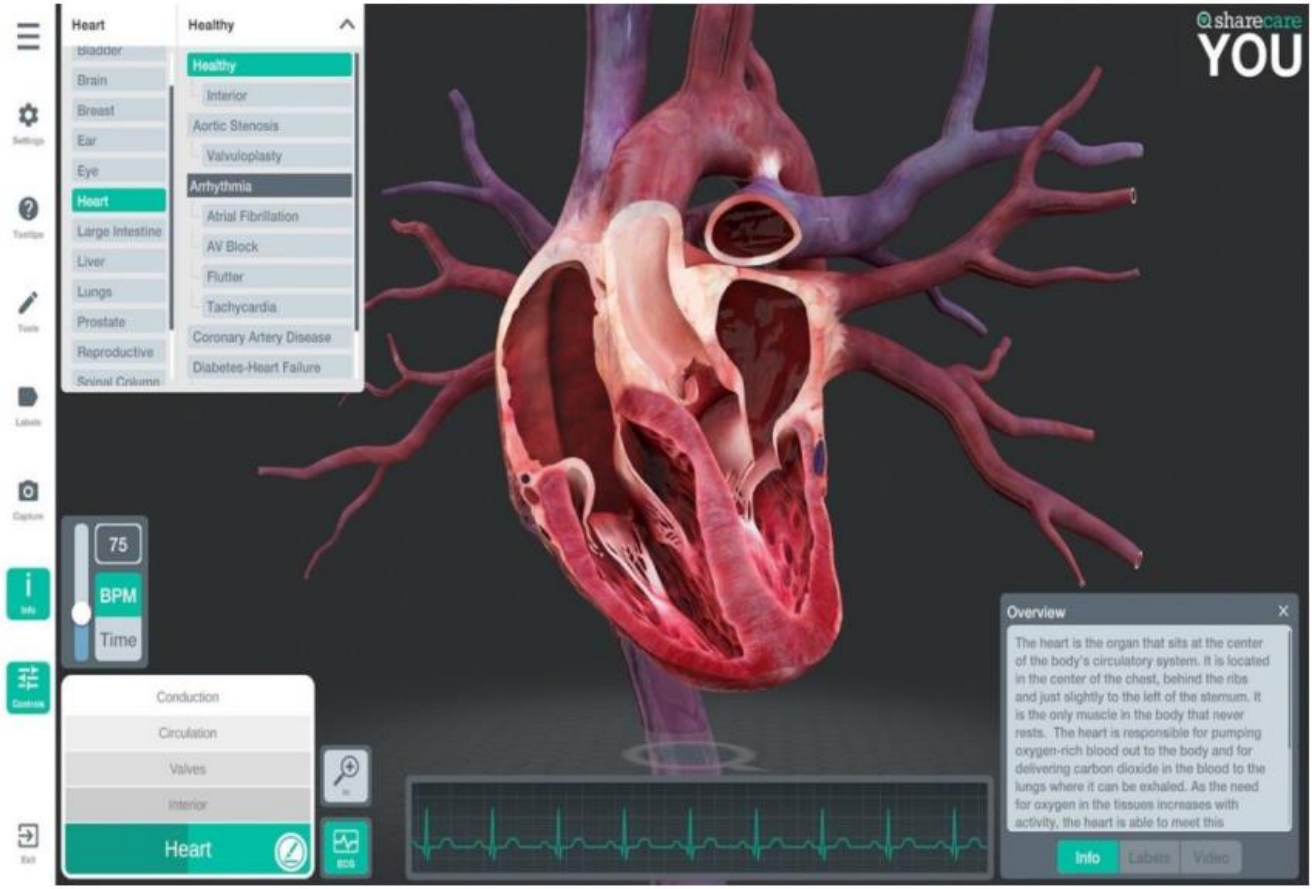
Hardware

Features	Specifications
Display type	2 x AMOLED Peripheral displays. Focal area: uOLED displays
Resolution	440x1600 per eye Peripheral displays. Focal displays: 1920x1080
Refresh rate	90 Hz Peripheral displays. Focal displays: 60 Hz
Field of view	87° horizontal 87° vertical
IPD Range	61-73 mm software adjustable
Weight	605 g with a head strap

VARJO-VR2 HMD

Experimental Study Design

Software



An Overview of the Sharecare YOU Software.

- 3D heart contents and videos.
- Tools and functionality.
- Compatible with all major VR headsets.
- Minimum computer requirements.

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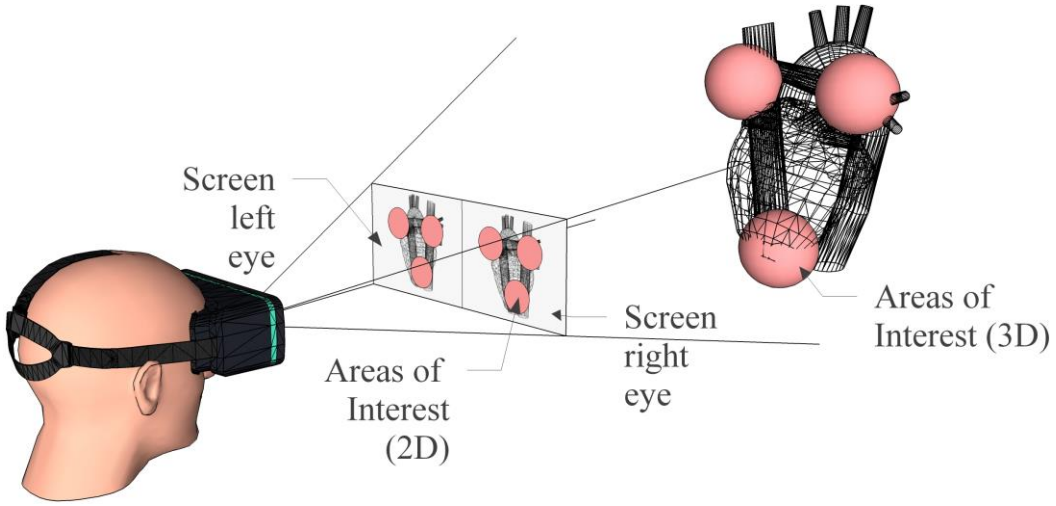
Experimental Study Design



AOI in 2D and 3D space

A user with complete eye-tracking / VR setup

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Exploratory Data Analysis

	A	B	C	D	E	F	M	N	O	P
1	raw_timestamp	relative_to_video	focus_distance	frame_number	stability	status	gaze_projected_to_left_view_x	gaze_projected_to_left_view_y	gaze_projected_to_right_view_x	gaze_projected_to_right_view_y
2	1.00001E+18	62986300	2	546997	0	2	0.181708	-0.334642	-0.208161	-0.335142
3	1.00001E+18	82989600	2	546999	0	2	0.189076	-0.131658	-0.197014	-0.131829
4	1.00001E+18	92981500	2	547000	0	2	0.195537	-0.105573	-0.19022	-0.105702
5	1.00001E+18	103178200	2	547001	0	2	0.162254	-0.116715	-0.224076	-0.116862
6	1.00001E+18	113108300	2	547002	0	2	0.168641	-0.120221	-0.217625	-0.120373
7	1.00001E+18	143112700	2	547005	0	2	0.190046	-0.076284	-0.195573	-0.076365
8	1.00001E+18	153115000	2	547006	0	2	0.174136	-0.091317	-0.211806	-0.091422
9	1.00001E+18	163124800	2	547007	0	2	0.210139	-0.027868	-0.175019	-0.027871
10	1.00001E+18	173211700	2	547008	0	2	0.207127	-0.037383	-0.178093	-0.037402
11	1.00001E+18	183231800	2	547009	0	2	0.204767	-0.023715	-0.180449	-0.023711
12	1.00001E+18	193209100	2	547010	0	2	0.182549	-0.074787	-0.203165	-0.074866
13	1.00001E+18	203277800	0.082006	547011	0	2	0.166017	-0.075268	-0.219939	-0.075347
14	1.00001E+18	213207700	0.502107	547012	0	2	0.170246	-0.116734	-0.215964	-0.116881
15	1.00001E+18	223271900	0.263447	547013	0	2	0.168972	-0.103364	-0.217139	-0.103489
16	1.00001E+18	233386300	0.40023	547014	0	2	0.17494	-0.092396	-0.210999	-0.092504
17	1.00001E+18	243334400	0.379673	547015	0	2	0.174177	-0.083367	-0.21171	-0.08346
18	1.00001E+18	253333800	0.761205	547016	0	2	0.171964	-0.086488	-0.213976	-0.086586
19	1.00001E+18	263333200	2	547017	0	2	0.20803	-0.068129	-0.177309	-0.068197
20	1.00001E+18	273365400	2	547018	0	2	0.204113	-0.063922	-0.181252	-0.063983
21	1.00001E+18	283394400	2	547019	0	2	0.190208	-0.092571	-0.195518	-0.092679
22	1.00001E+18	293356400	2	547020	0	2	0.201476	-0.090311	-0.184085	-0.090415
23	1.00001E+18	303528100	2	547021	0	2	0.200814	-0.08674	-0.18473	-0.086838
24	1.00001E+18	313483500	2	547022	0	2	0.205776	-0.047139	-0.179494	-0.047174
25	1.00001E+18	323486100	2	547023	0	2	0.200528	-0.068749	-0.184909	-0.068818

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Result And Discussion

TTFF – Time to first fixation

DT- Dwell time

RV – Revisit

RV (DT) – Revisit dwell-time

Metrics	AOI-1 (ms)	AOI-2 (ms)	AO1-3 (ms)
TTFF	88200	150000	243600
DT	102000	49000	36000
RV	_	2000	4000
RV(DT)	_	4000	8000

Table showing fixation data

Result And Discussion

	Pearson Correlation, r	**Sig., p**
% increase on Post-intervention quiz and fixation data	0.686	< 0.05
Indication	Significant ,moderate positive correlation	

- **RQ1**: Is it possible to record eye-tracking data from off-the-shelve software without implementation of specific eye-tracking SDKs? **YES**
- **RQ2**: Is it possible to see gaze replays and determine the participants fixation from the eye-tracking data? **YES**
- **RQ3**: From the analysis of eye-tracking data, is it possible to forecast the user's learning performance? **SIGNIFICANT CORRELATION**

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Conclusion

Summary

- Assessment of students learning performance using off-the-shelve VR software is possible.
- Positive correlation between students performance and visual attention.
- Participants gaze data proved their attention on specific AOIs marked out.
- Raises students' motivation
- Positive learner experience
- 3rd Party predesigned VR software can be used for recording eye-tracking data, medical training, and tasks.

Outlook

- Using AI methods to automatically detect semantic features within a VR scene and then re-detect those from any position within the 3D space
- Use a 3D-3D point set registration between derived 3D-eye-tracking points, live positional tracking data of the VR headset and the gazed-at point within the 3D scene.

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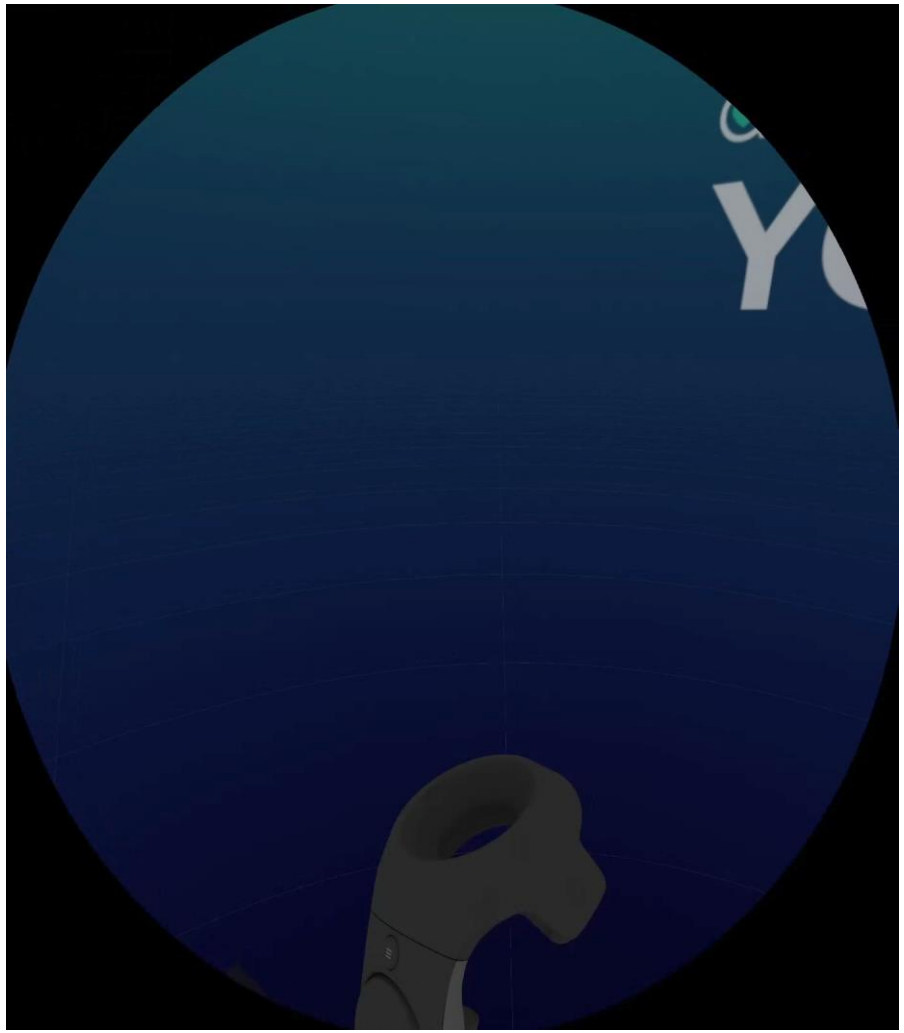
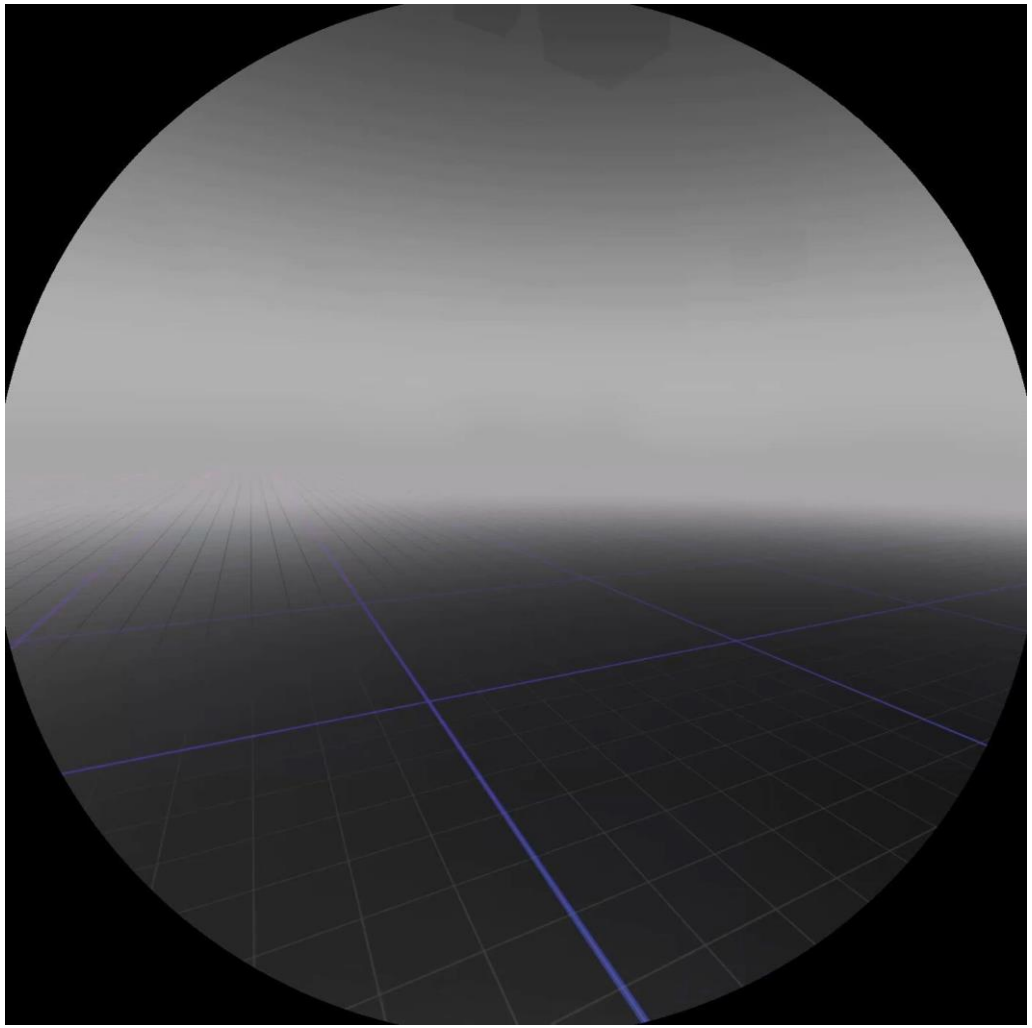
VR Session



Overlay



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Thank you - Any questions?