Eyeglasses Impact in Eye Tracking with HMDs

by Pedro Moço

Research Question

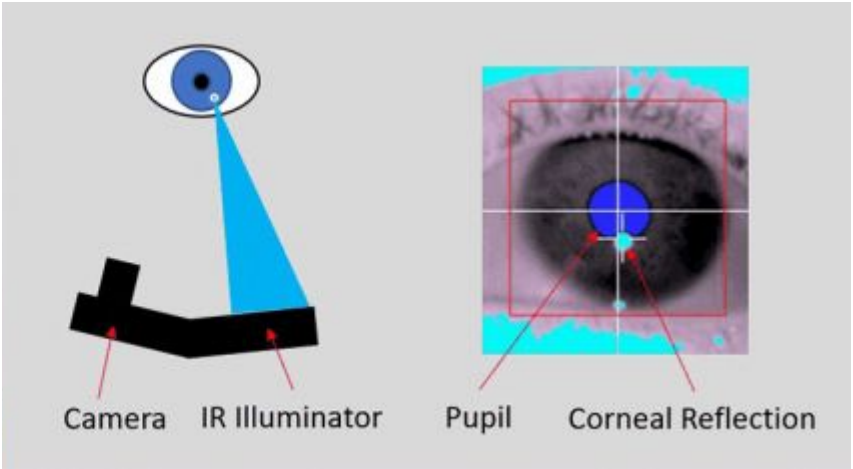
What is the effect of wearing corrective glasses when using HMDs with eye-tracking devices incorporated?

What characteristics of optical corrective eyewear most impact the quality of eye-tracking data thus collected?

How do these constraints compared to Desktop EyeTracking (Tobii findings)

Hypothesis

The use of corrective eyeglasses will introduce deviations in eye tracking data collected by head-mounted displays (HMDs) due to the nature of the lenses' refractive power, correction type, and lens coating.
Even after the use of the current calibration software present in HMDs.



Experimental Plan

Participants

- use glasses
- don't use glasses
- Ophthalmological assessment
  - have any other eye illness

Task (set up)

- every person will perform the task with all chosen glasses and without them

Standardization

standard glasses chosen by profesional

- increase standardization between all sample groups
- everyone does task with all glasses and without glasses

Data

- every frame data collection
- saved in a CSV file
- template :
  - TimeStamp,
  - userId
  - TaskType
  - GazeDeviationX
  - GazeDeviationY
  - DistanceDeviation
  - tagId
  - state

Expectation

- correlation : increased glass strength and increased deviation
- no glasses having lowest deviation

Task

- targets will appear on screen
- one after the other
- randomly ordered
- Participants will be instructed to locate and focus on the target

Data Analysis

- After outliers and mistests are removed
- group up by glasses used (TaskType)
- check deviations based on glasses power
- check any bias in the participant pool

Calibration

- every task/glass change
- every participant
- procedure of calibration (10s +-)
- provided by the HMD manufacture

Software Design

There are two main sections on this app :

“**Menu**” - holds all of the features to set up the task :

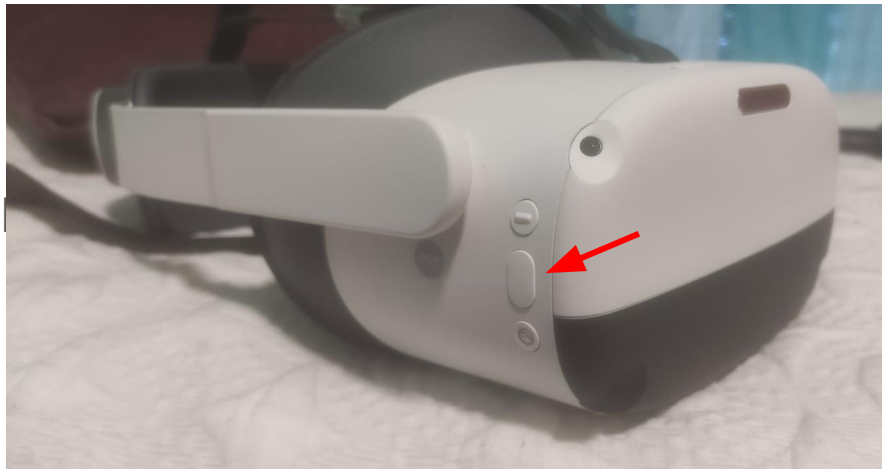
- Settings for this particular task
- Start Task
- Retire last user Id
- Increment User Id

Task” - controls the flow of the task :

- Randomize order of targets
- Animate Targets
- Records the EyeGaze hitpoint
- Sends data to logging

MENU- UI

- Screen centered crosshair as a selection tool, similar to the mouse icon.
- Head movement to aim the cross
- Right side CONFIRM Button to represent the click.

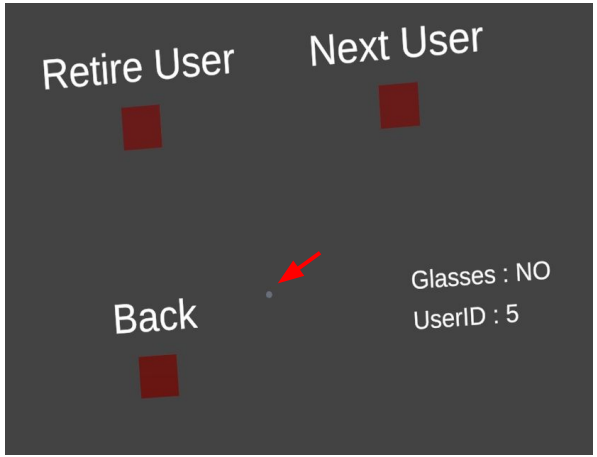


MENU- GUI

- center crosshair
- square buttons
- light up on hover

Confirm button (HMD right side larger button)

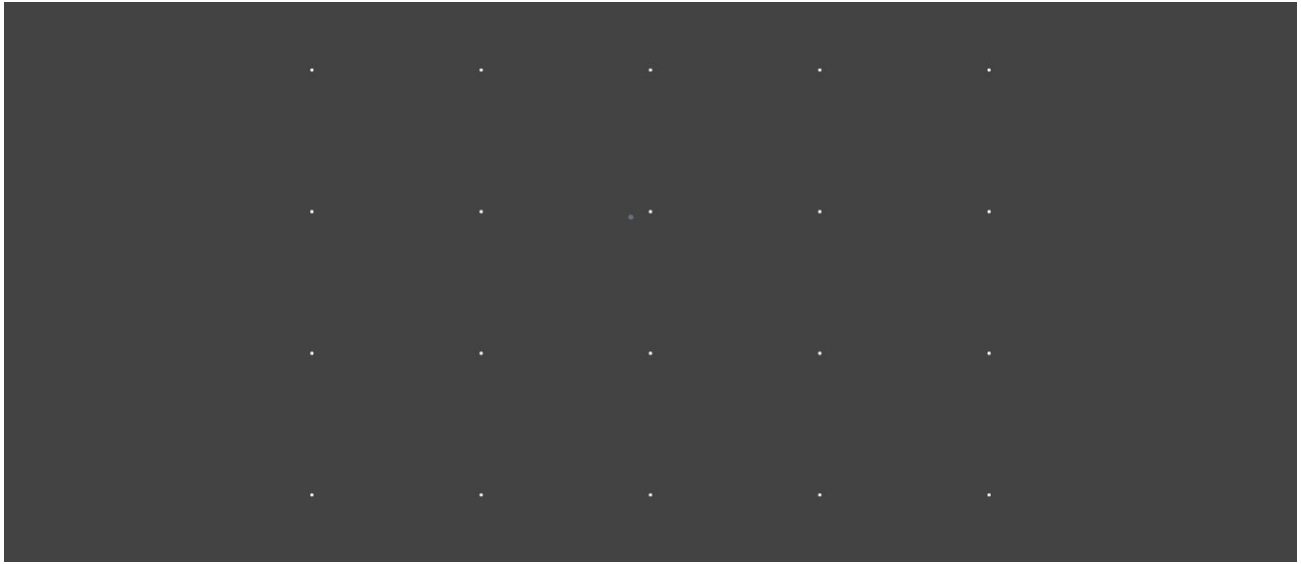
- Main Page :
  - set up the current task (which glasses are being used)
  - starts task
- User Settings:
  - retires a user (prints a line to the logs that this user has been removed)
  - Increments the User Id ;



Task

the task screen is divide in 28 areas.
(the columns furthest from the center serve has padding)

The 20 inner ones have a small white dot that serves as a target.
All targets are inside the visible scope of the screen in the VR.
the screen is deformed to be read as 3D field.



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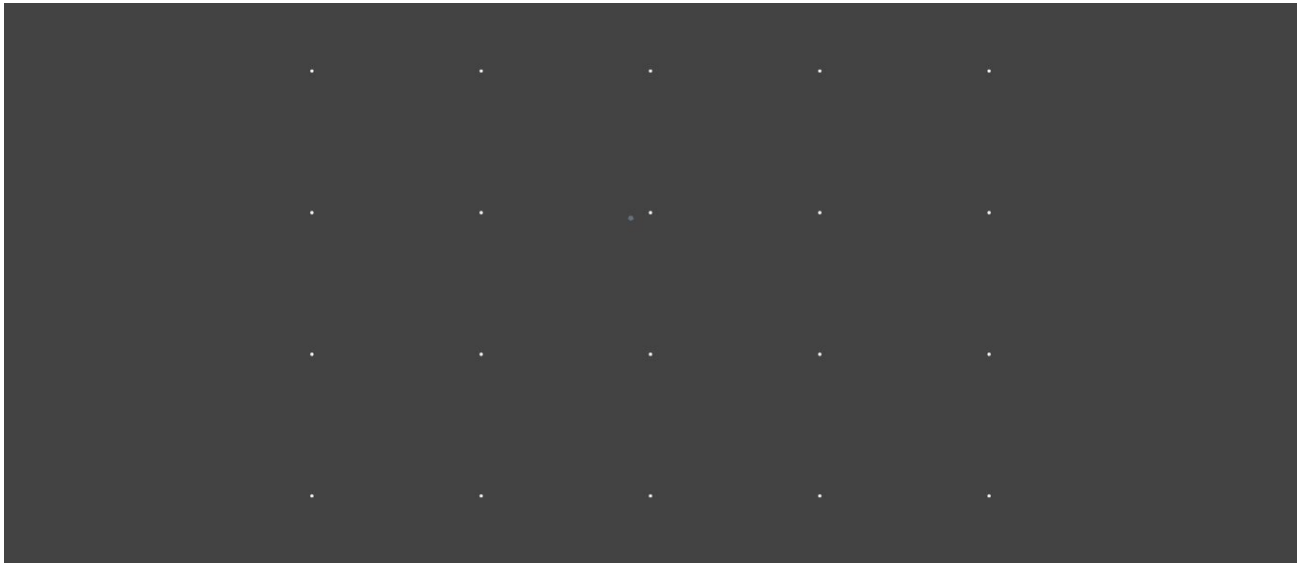
As you can see the targets stand close to the edge of the visible/focusable scope.



Targets appear sequentially one after the other in a randomized order. Each target :

- fades in, scaling down
- remains for a few seconds
- fades out

TASK- UI

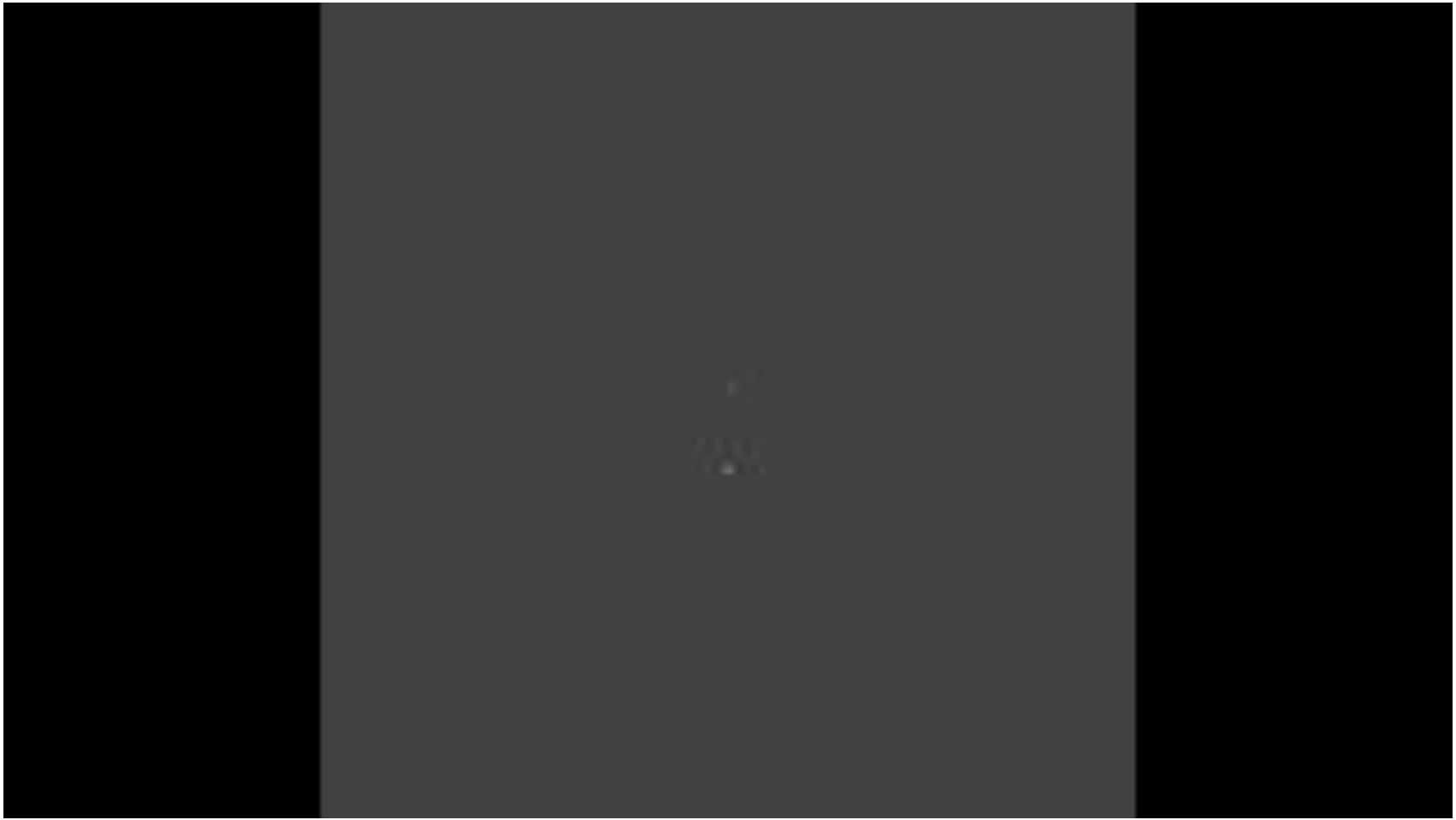
The screen is fixed.

Head movement won't be recorded by the HMD.

Moving, tilting or any other spatial change of the Head, won't affect what people are seeing in the VR.

- Forces the use of maximum range of the gaze
- Ignores any miniscule movement that could deviate the recording
- to avoid Motion sickness, it's advisable to have the participant sit and rest the head on his arms.
- Ignores the natural urge to face that direction by rotating or turning the head instead of the gaze.

No other interaction will occur during the task.
The Participant is simply to focus on the targets and wait until the Task has ended and the Menu is showing again.



Logging

The logs are saved every frame in a CSV file, in the HMD, in the files folder inside installation folder.

ex: *...\Pico Neo 3 Pro Eye\Internal shared storage\Android\data\com.Xavier.XAVIEREyetrackingPICO\files* ***Results.csv***

the template follows the format.

TimeStamp, userId, TaskType, GazeDeviationX, GazeDeviationY, DistanceDeviation, tagId, state

```
2023/03/09 12:24:11.087, 0, -1.0, 266.5978, -362.6607, 450.1079, 44, FadeIn
2023/03/09 12:24:11.101, 0, -1.0, 275.7938, -364.1653, 456.8135, 44, FadeIn
2023/03/09 12:24:11.116, 0, -1.0, 273.1331, -360.997, 452.6815, 44, FadeIn
2023/03/09 12:24:11.129, 0, -1.0, 273.1407, -361.0094, 452.696, 44, FadeIn
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2023/03/09 12:24:11.158, 0, -1.0, 275.1512, -368.0439, 459.5264, 44, FadeIn
2023/03/09 12:24:11.171, 0, -1.0, 274.5508, -365.7428, 457.3248, 44, FadeIn
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2023/03/09 12:24:11.213, 0, -1.0, 275.8198, -367.2875, 459.322, 44, Showing
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