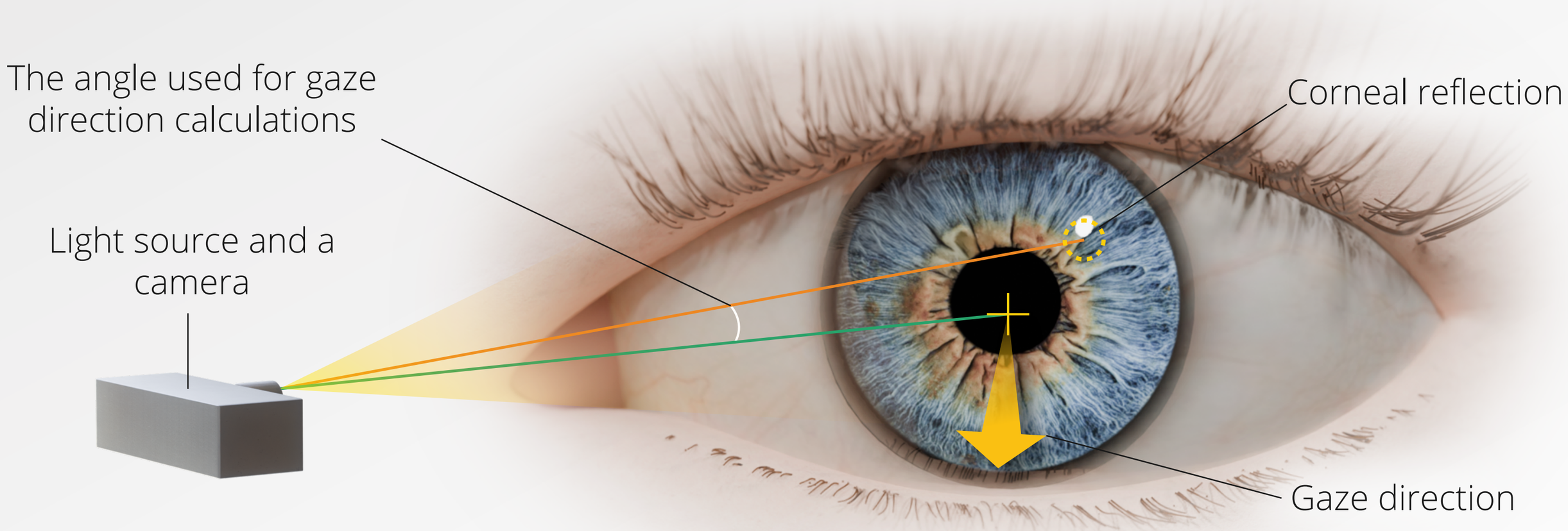
The Science of Eye Tracking



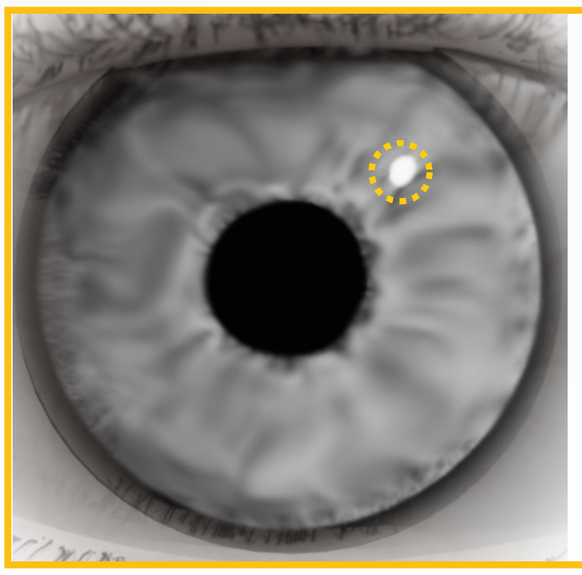
Eye tracking measures where a person is looking by analyzing corneal reflections and the pupil center. A light source near the camera creates a reflection on the cornea, while the camera detects the position of the pupil.

The angle between these two points is used to calculate the gaze direction, revealing where attention is focused. This simple principle underpins almost all eye-tracking systems (with the notable exception of machine learning-based methods.)

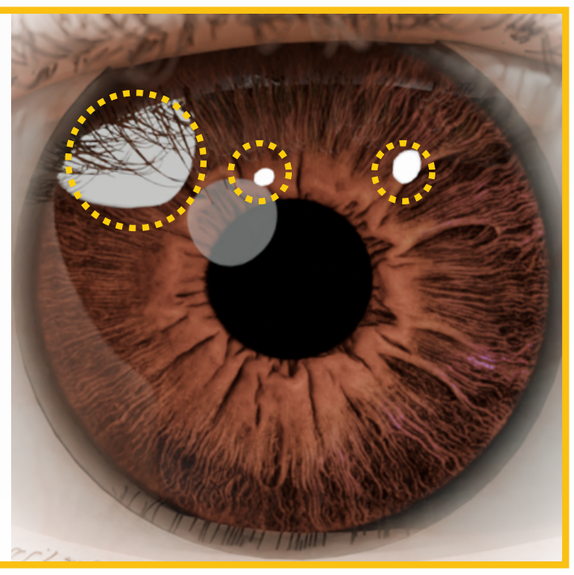
Why Infrared Light?

While the earlier illustration shows visible light, most eye-tracking systems rely on infrared (IR) light due to its precision and reliability. IR light creates distinct corneal reflections, improves pupil visibility, and performs consistently across varied lighting conditions. By minimizing interference from ambient light and providing high contrast between the pupil and iris, IR ensures accurate and dependable tracking.

IR Spectrum



Visible spectrum



Did you know? The problem with Laser Surgery

Normal cornea

Laser-treated cornea

Laser eye surgery, such as LASIK or PRK, reshapes the cornea to correct vision by altering its curvature. These changes affect how light reflects off the corneal surface, which is a critical component for calculating gaze direction in eye tracking. Because this can lead to calibration errors or inconsistent tracking data, it is generally considered best practice to exclude participants with a history of laser eye surgery from studies requiring high precision.

Using 3D simulation, we show how even small changes in corneal curvature can create significant differences in light reflections. These subtle alterations have a major impact on the accuracy of gaze tracking, highlighting the challenges posed by laser eye surgery.

3D Simulation

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