Figure S1. Block diagram of process to determine subject motion in world. $P_0$ is the camera projection matrix for the first frame, which is aligned with the world coordinate system.

Figure S2. Block diagram of process to determine subject 3D POR in world.
Detect Pupil and CR, correct Pupil position for camera translation.

Get mapping from Eye to POR in scene images.

Obtain 2D POR in each scene frame.

Get 3D POR in world for each frame.

Get subject position and orientation for each frame.

Have subject look at 9 known points in scene.

Select image coordinates for these points and extract Eye array values that correspond to these points.

(Transformation matrix from eye image coordinates to scene image coordinates)

(Figure S2)

(Figure S3)

Subject calibration

<table>
<thead>
<tr>
<th>Variable Dimensions</th>
<th>Coordinate system</th>
<th>Eye Image</th>
<th>Scene Image</th>
<th>World</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>2xF</td>
<td>2xF</td>
<td>3xF</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4xF</td>
<td>4xF</td>
<td>3xF</td>
</tr>
</tbody>
</table>

*F = number of frames
Figure S4. Subject wearing RIT Wearable Eye Tracker (left). Marked points correspond to Fig. S5. For this project, we used an additional HD camera (shown mounted on bicycle helmet in left image). Close-up of eye tracker headgear (right) [Babcock, J. S., and Pelz, J. B. 2004. Building a lightweight eyetracking headgear. In ETRA 2004: Proceedings of the Eye Tracking Research & Applications Symposium, ACM Press, New York, NY, USA. 109-114].

Figure S5. Results for 6 fixation points (as marked in Figure S4). Distances between points were measured with a tape measure (+) and compared to results of proposed algorithm (x).