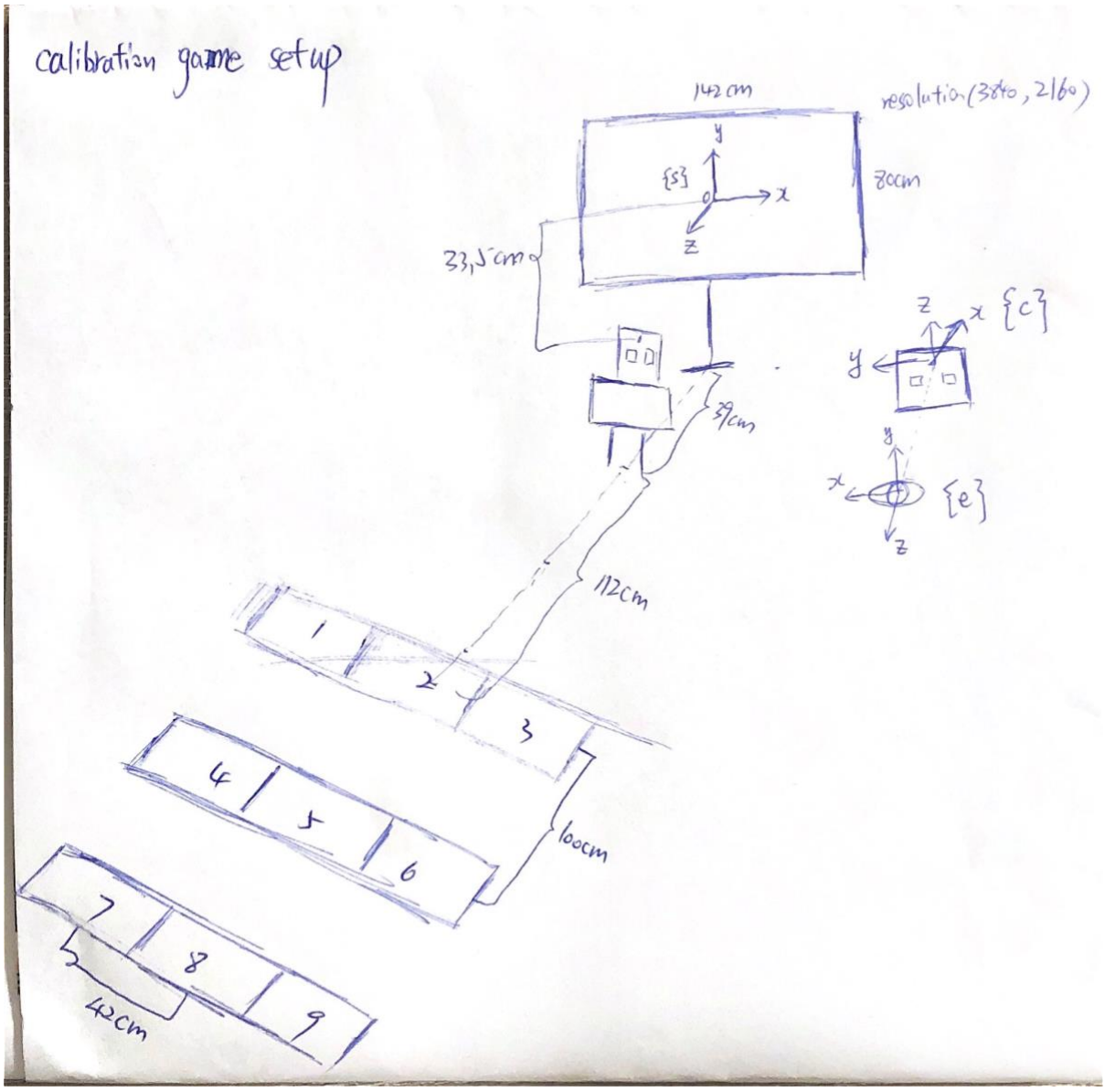
How to get gaze direction in calibration game experiment?

Distance from screen to ground is 108cm



calibration output : (x_p, y_p) units: pixel

$$x_s = x_p \cdot \frac{142}{3840}$$

$$y_s = y_p \cdot \frac{80}{2160}$$

$$z_s = 0$$

dots in {s} : (x_s, y_s, z_s) units: centimeter

reference coordinate system (RCS)

${}^cR_s$: the rotation matrix of {s} in {c}.

${}^cP_{so}$: the position of the origin of {s} in {c}.

$${}^cP = {}^cR_s\,{}^sP + {}^cP_{so}$$

$$\begin{bmatrix} x_c \\ y_c \\ z_c \end{bmatrix} = \begin{bmatrix} 0 & 0 & -1 \\ -1 & 0 & 0 \\ 0 & 1 & 0 \end{bmatrix} \begin{bmatrix} x_s \\ y_s \\ z_s \end{bmatrix} + (39, 0, 33.5)$$

$$\Rightarrow \begin{cases} x_c = -z_s + 33.9 \\ y_c = -x_c \\ z_c = y_s + 33.5 \end{cases}$$

dots in {c} : (x_c, y_c, z_c)

gaze = target 3D − eye 3D

$$(x_c^g, y_c^g, z_c^g) = (x_c, y_c, z_c) - (x_c^h, y_c^h, z_c^h)$$

gaze direction in {c}: (x_c^g, y_c^g, z_c^g) ← (x_c^h, y_c^h, z_c^h) human eye in {c}

$$(x_c^{gn}, y_c^{gn}, z_c^{gn}) = \frac{(x_c^g, y_c^g, z_c^g)}{\sqrt{(x_c^g)^2 + (y_c^g)^2 + (z_c^g)^2}}$$

unit gaze direction in {c}: $(x_c^{gn}, y_c^{gn}, z_c^{gn})$ similarly, get $(x_c^{hn}, y_c^{hn}, z_c^{hn})$

${}^e_cR$: the rotation matrix of {c} in {e}

$$(x_e^g, y_e^g, z_e^g) = (x_c^{gn}, y_c^{gn}, z_c^{gn}) \cdot {}^e_cR$$

gaze direction in {e}: (x_e^g, y_e^g, z_e^g)

PS: (x_c^h, y_c^h, z_c^h) → f → ${}^e_cR$ f is the function of 'getLadybugToEyeMatrix' in Z1]

reference

[1]https://github.com/erkil1452/gaze360/issues/30
[2]https://github.com/erkil1452/gaze360/tree/master/dataset