

[DEMO] INDICA : Interaction-Free Display Calibration for Optical See-through Head-mounted Displays based on 3D Eye Localization

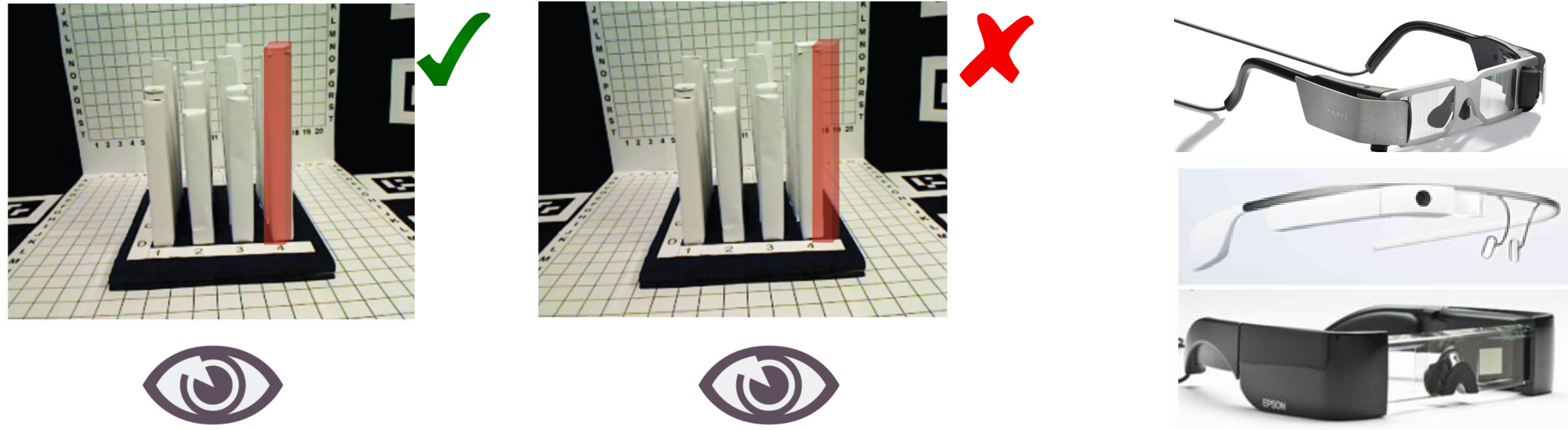
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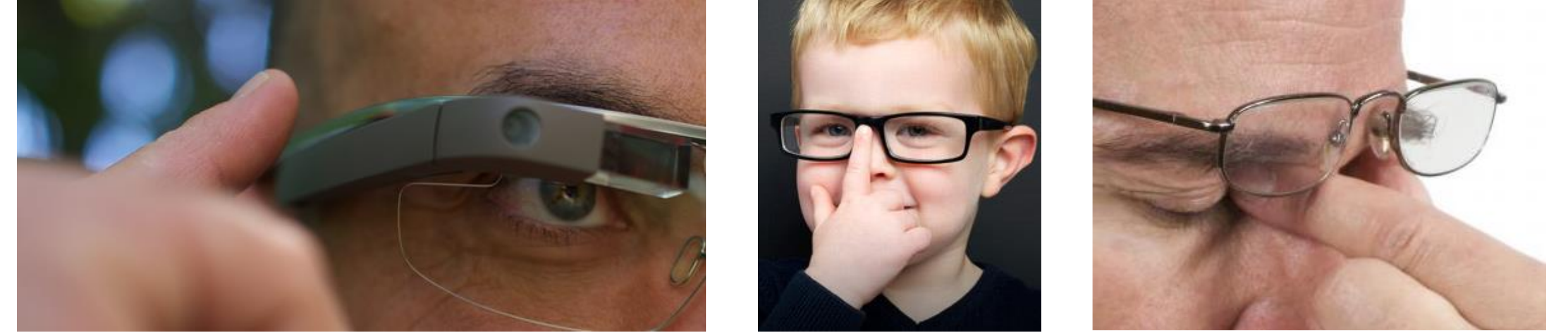


Why is HMD Calibration Important?

A correct spatial registration of **Optical See-Through Head-Mounted Displays (OST-HMD)** w.r.t. a user's eye(s) is an essential problem for any AR application using the such HMDs.



Maintaining the correct registration demands frequent **(re)calibrations** for the end-users whenever they move the HMD on their head (Touching, rubbing eyes etc.).



Our method utilizes dynamic **3D eye position** from an eye tracker in combination with pre-computed, static display parameters.

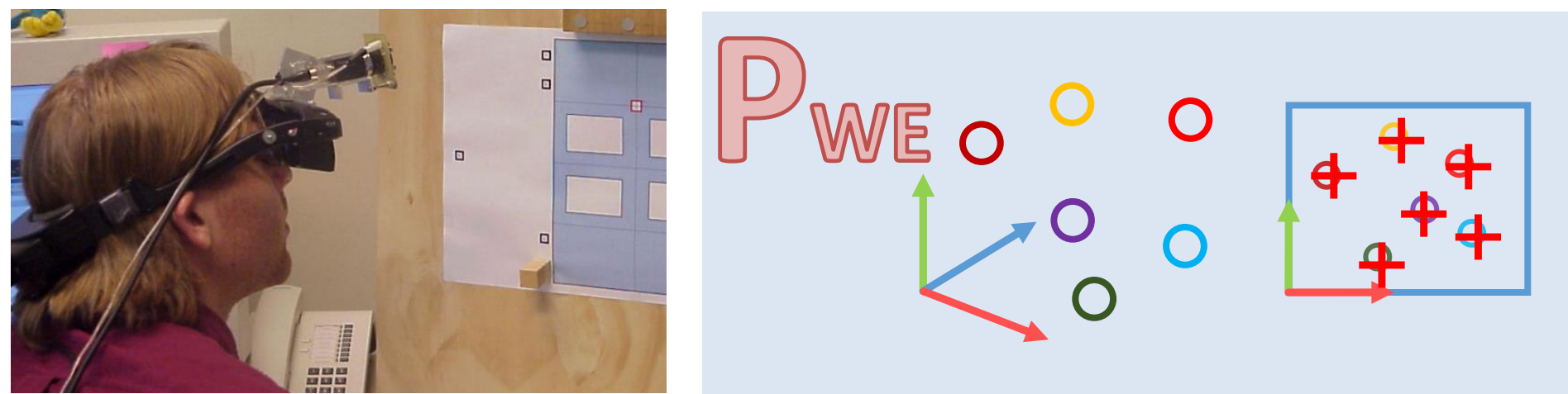
The result shows that our calibration with eye tracking is more stable than repeated **SPAAM calibrations**.



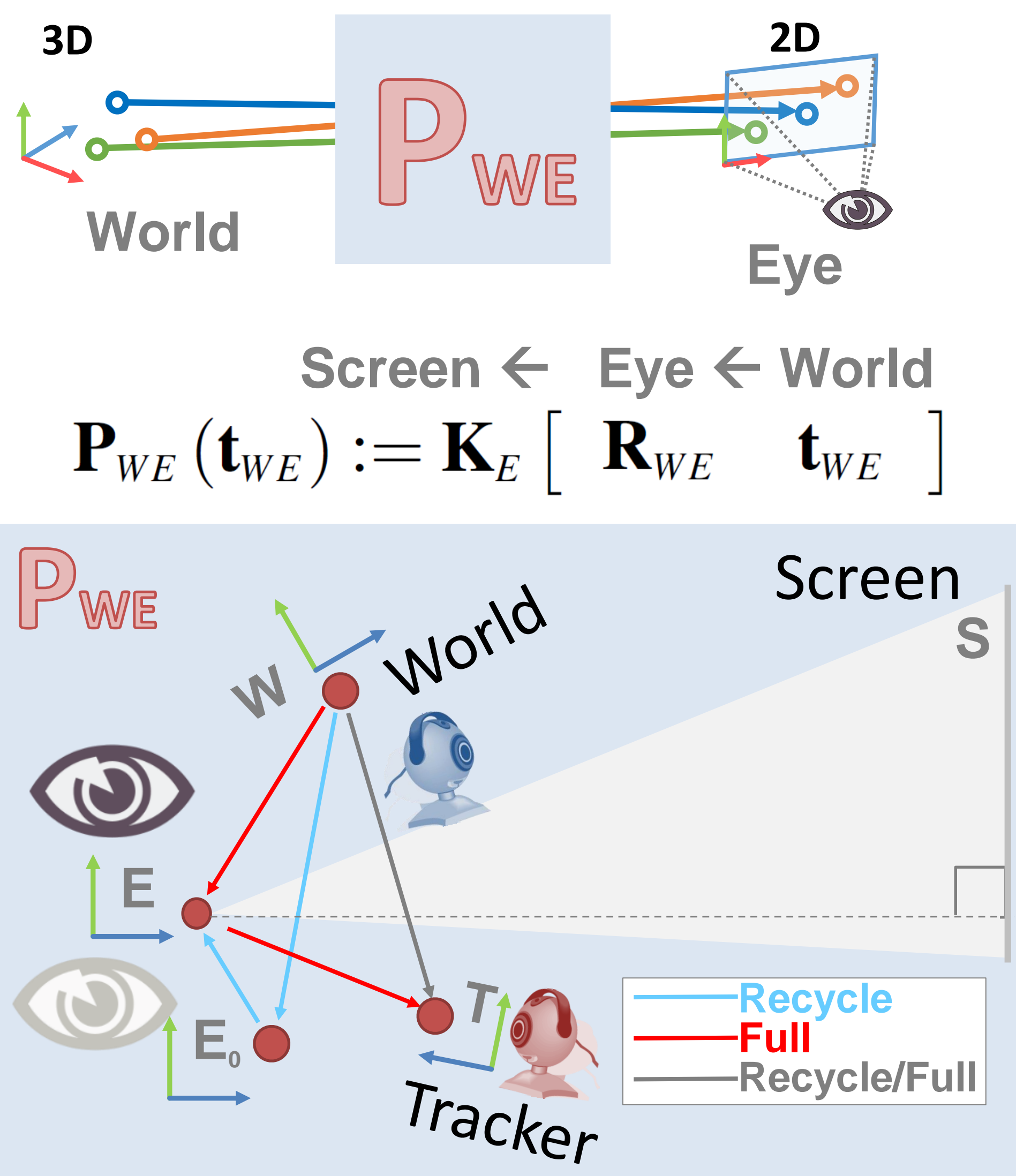
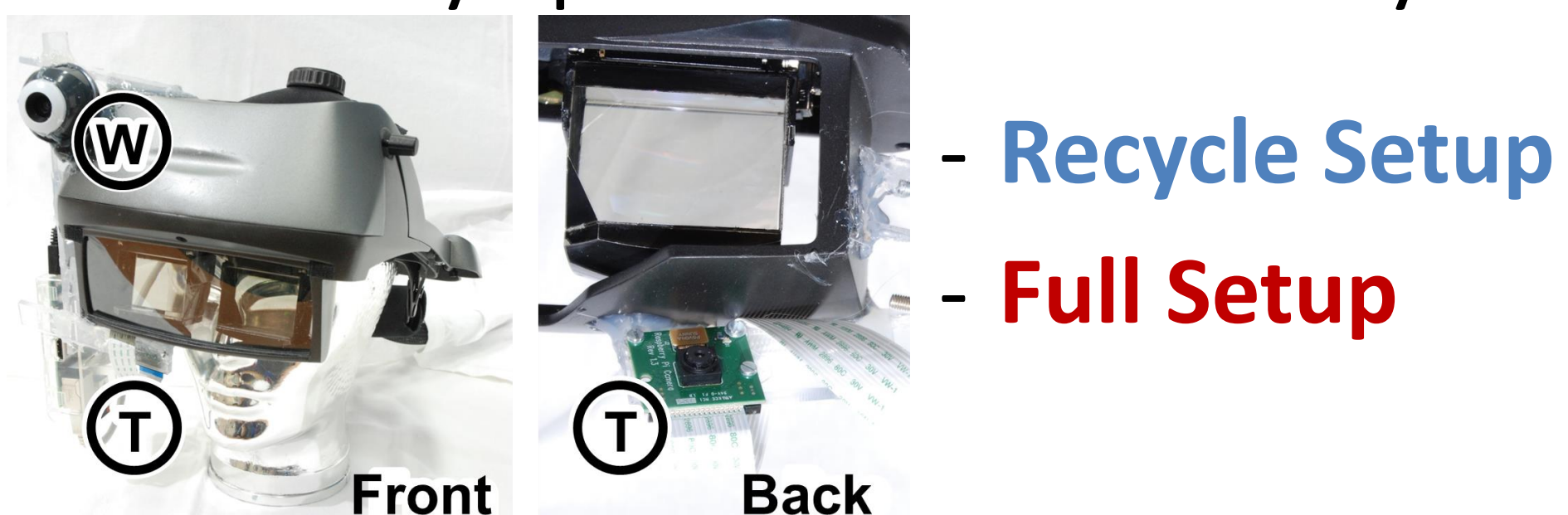
Problem Statement

Find World-to-Screen (3D-2D) Projection

- Manual Method: SPAAM (Single Point Active Alignment Method)



- Interaction-Free Method (**Proposed**) Estimate eye position automatically!

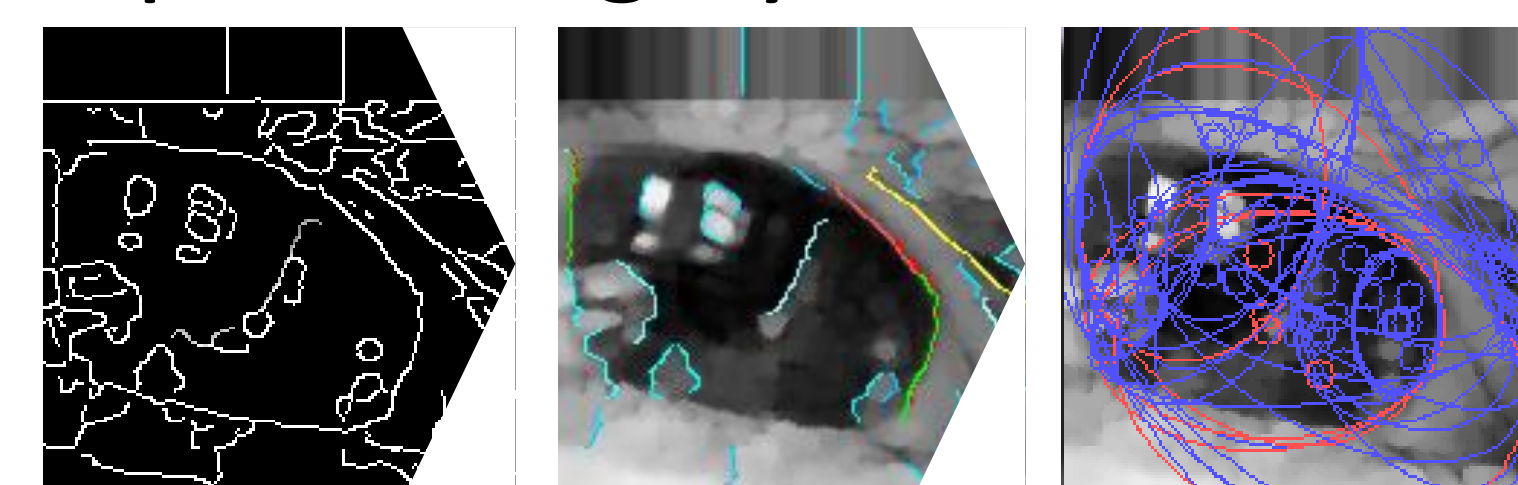


Eye Position Estimation

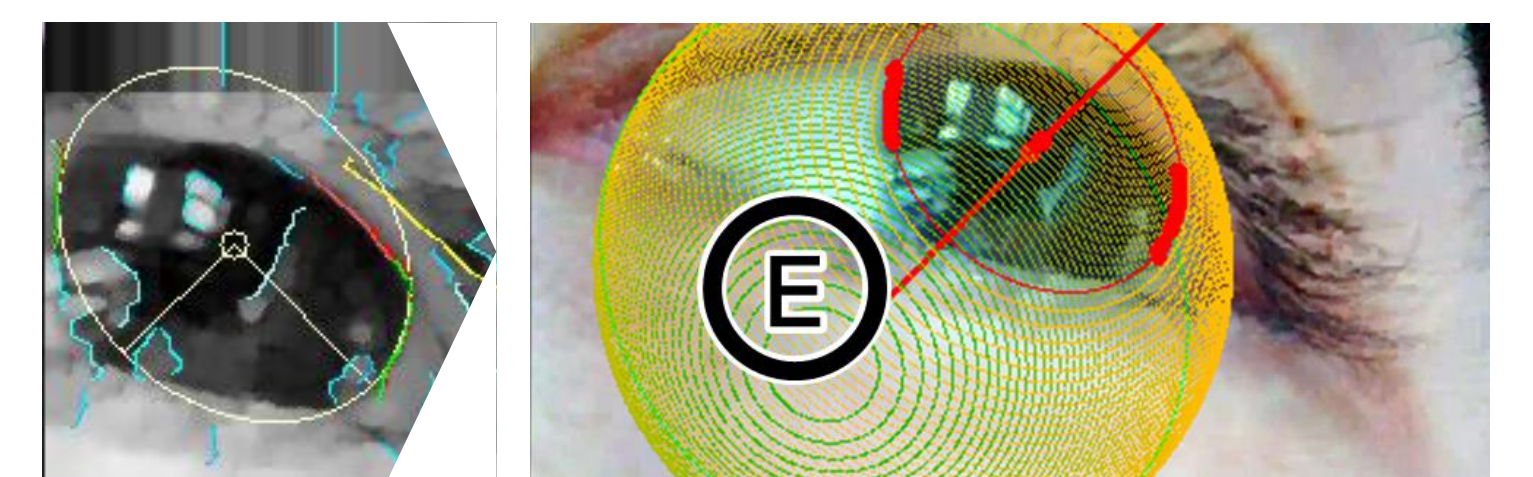
1. Estimate a 2D iris ellipse
 - Iris detection [3]



- Ellipse fitting by RANSAC

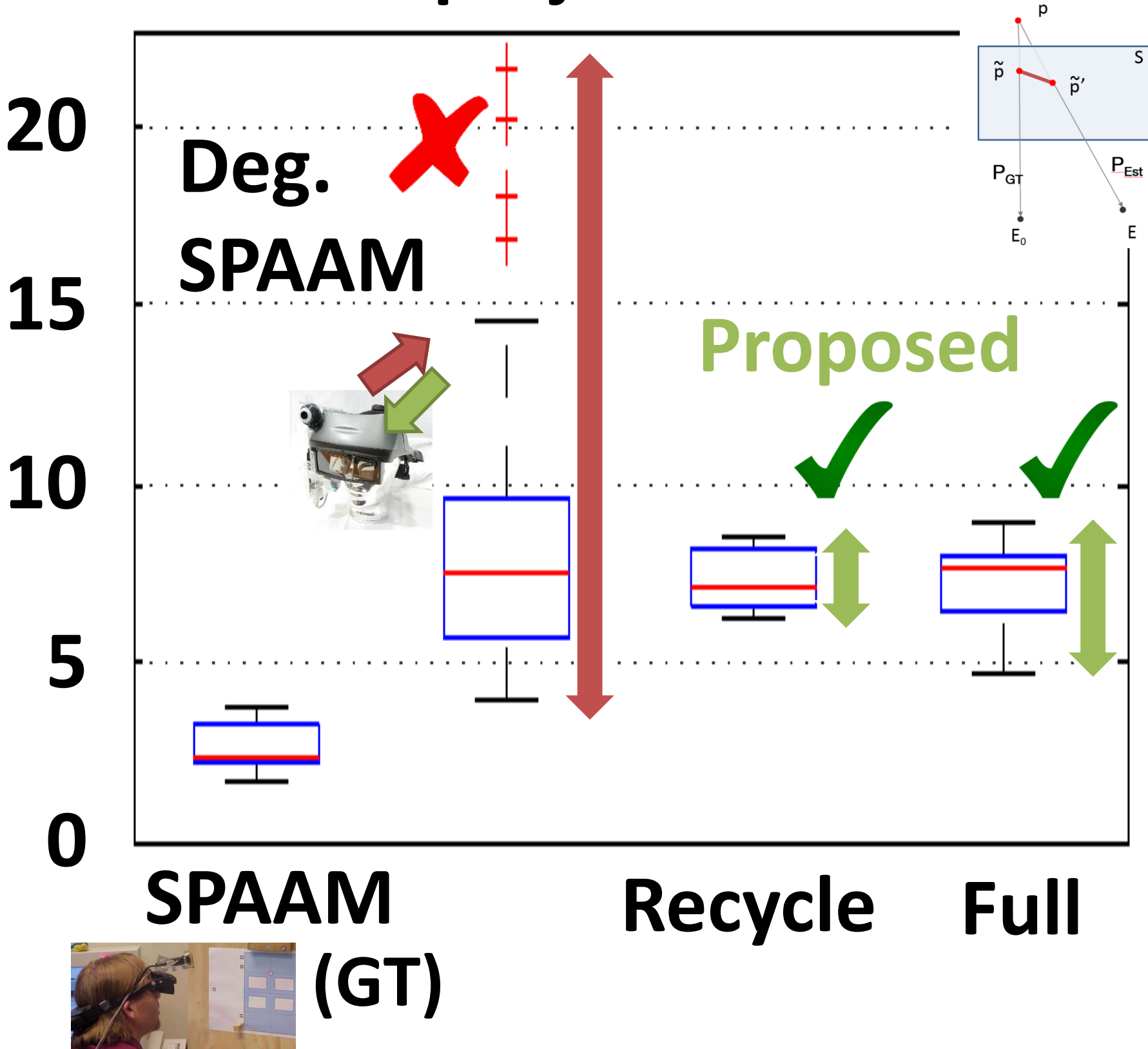


2. 3D Backprojection [2]

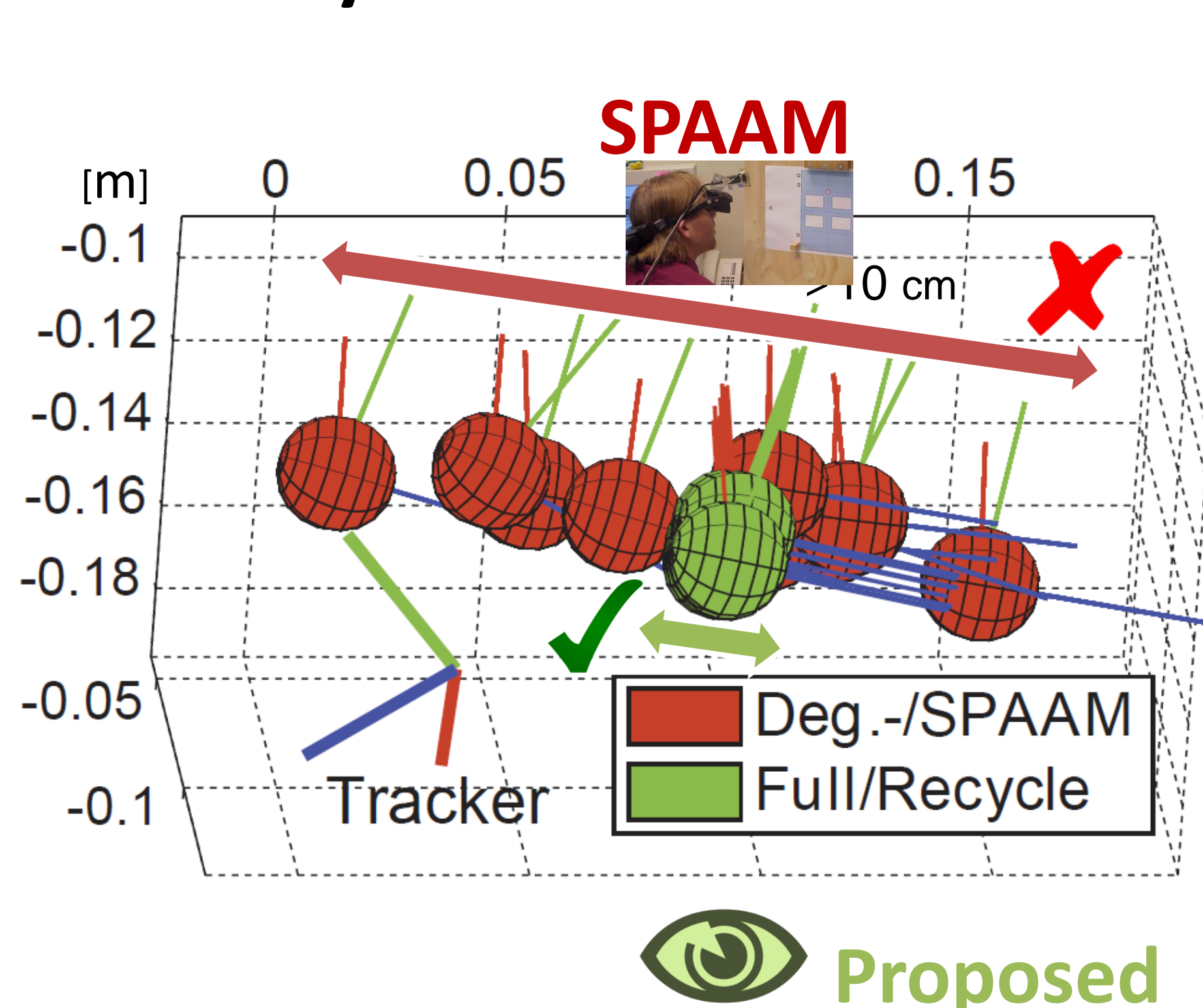


Experiments

2D Reprojection Errors



3D Eye Position Estimates



Comparison with a manual method: Single Point Active-Alignment Method (SPAAM [4]), The proposed method outperforms **Degraded SPAAM** with stable eye position estimates.

Conclusion

Calibration of OST-HMD using 3D eye position

- **Simple:** No user interaction required
- **Precise:** More stable than a conventional approach

More details
→ Our S&T talk on Fri
(Head-Worn Displays OST [S&T])

References

- [1] Y. Itoh, G. Klinker, "Interaction-Free Calibration for Optical See-Through Head-Mounted Displays based on 3D Eye Localization," 3D User Interfaces (3DUI), 2014, IEEE
- [2] C. Nitschke, A. Nakazawa, H. Takemura, "Image-based Eye Pose and Reflection Analysis for Advanced Interaction Techniques and Scene Understanding," SIG, 2011, IPSJ
- [3] L. Świrski, A. Bulling, N. Dodgson, "Robust real-time pupil tracking in highly off-axis images," ETRA, 2012, ACM
- [4] M. Tuceryan, N. Navab, "Single point active alignment method (SPAAM) for optical see-through HMD calibration for AR," ISAR, 2000, IEEE