Continuous Automatic Calibration for Optical See-Through Displays

Kenneth R. Moser
Mississippi State University

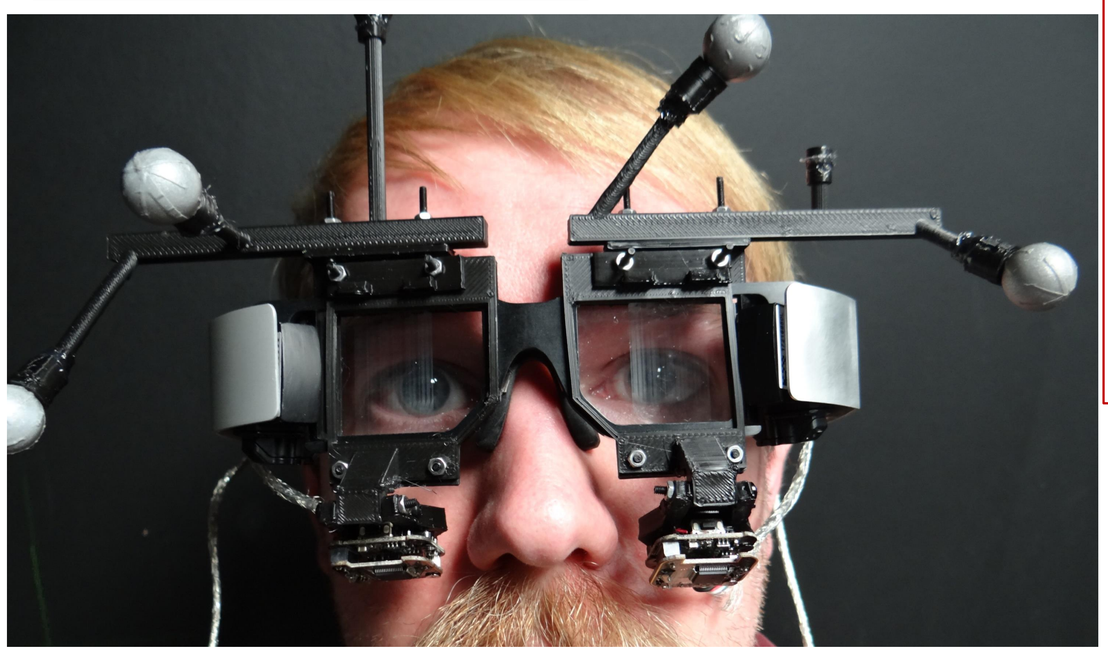
Yuta Itoh
Technical University Münich

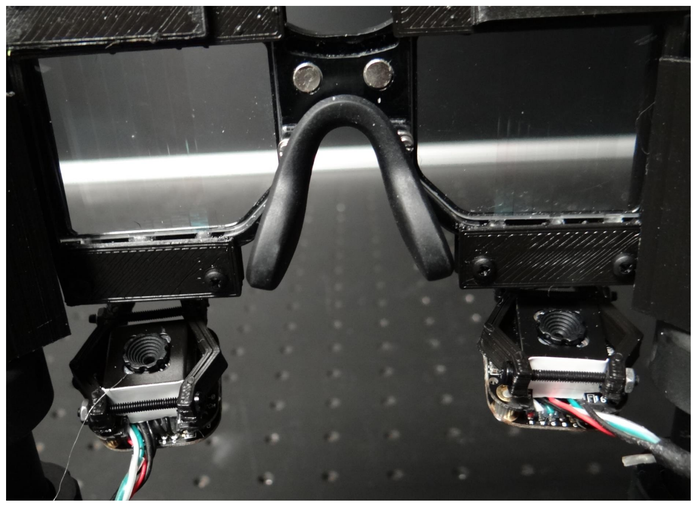
J. Edward Swan II
Mississippi State University

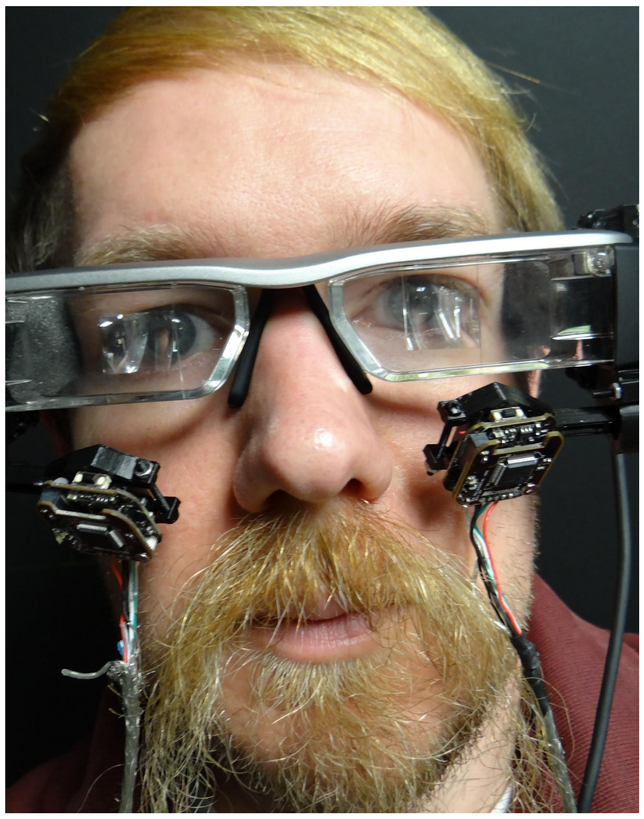
Abstract

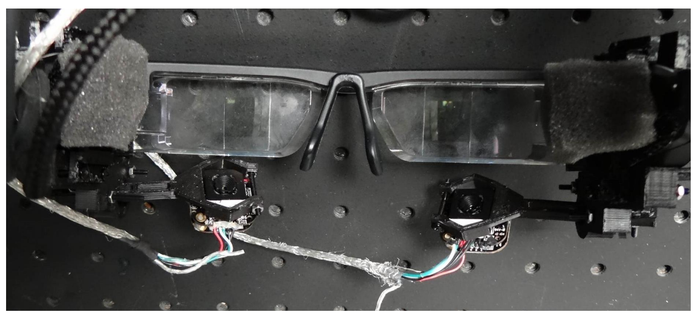
The current advent of consumer level optical see-through (OST) head-mounted displays (HMD's) has greatly broadened the accessibility of Augmented Reality (AR) to not only researchers but also the general public as well. This increased user base heightens the need for robust automatic calibration mechanisms suited for non-technical users. We are developing a fully automated calibration system for two stereo OST HMD's, a consumer level and prototype model, based on the recently introduced interaction free display calibration (INDICA) method. Our current efforts are also focused on the development of an evaluation process to assess the performance of the system during use by non-expert subjects.

Experimental Hardware and Design



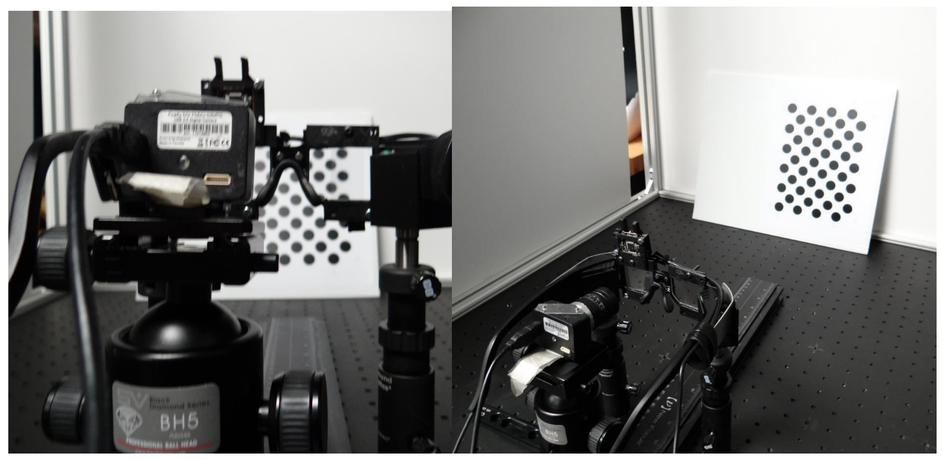


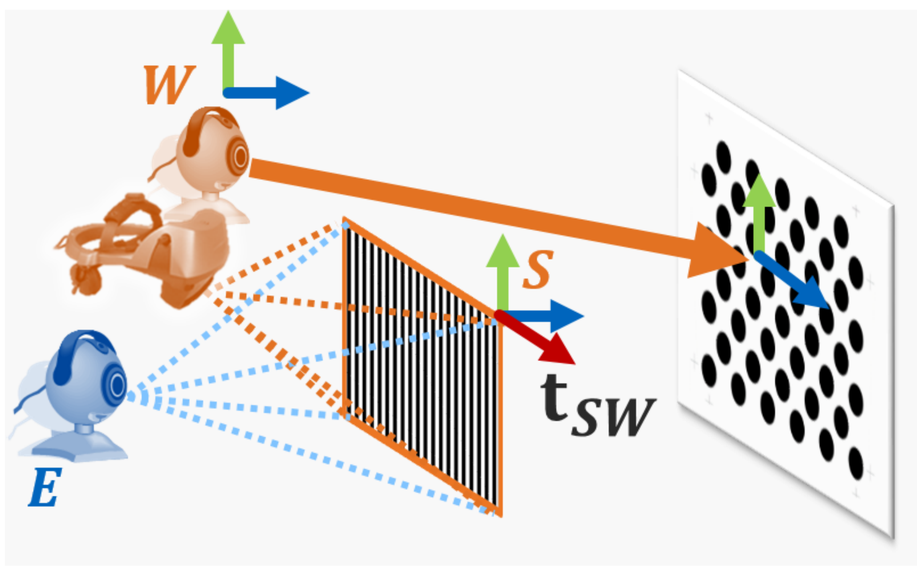




The OST HMD and mounted cameras system. (Top) User wearing the Lumus DK-32 HMD and added cameras. (Top Left) View of the camera mountings for the Lumus DK-32 from behind the display screen. (Bottom Left) View of the camera mountings for the Epson Moverio BT-200 from behind the display screen. (Bottom Right) User wearing the Moverio BT-200 and added camera assembly.

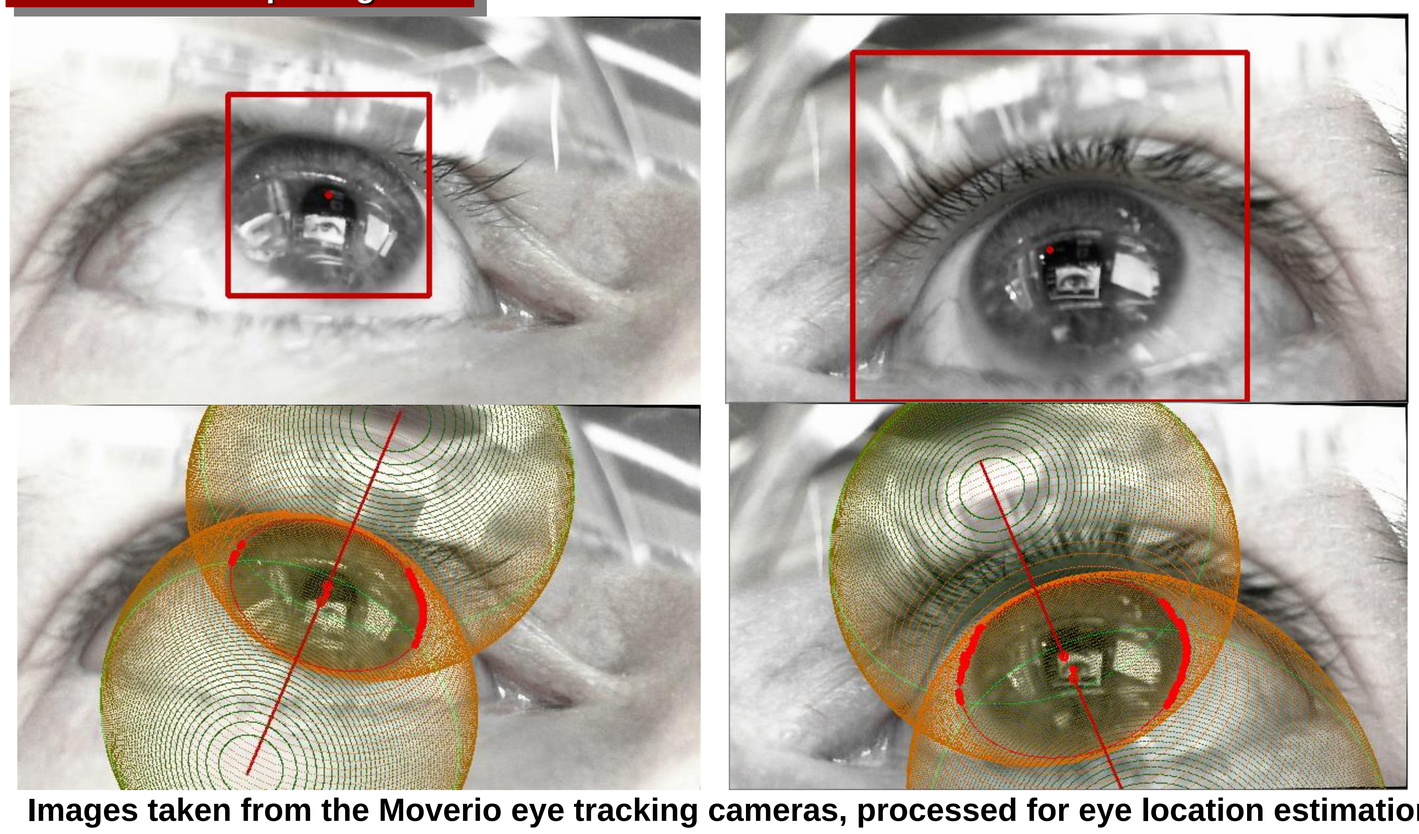
INDICA Full Setup: Stage One





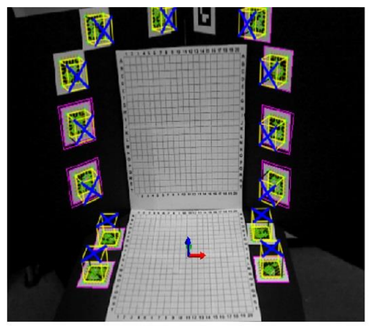
Views of the mounting rig used to measure the off-line INDICA parameters: Distance from the world tracking camera to the virtual screen, t_{WS}, as well as the scaling factors for projecting points into screen space, $\alpha(x,y)$. Two cameras are required to determine the transformation between the screen camera and the circular marker grid.

INDICA Full Setup: Stage Two



Images taken from the Moverio eye tracking cameras, processed for eye location estimation. Left image is the right eye, Right image is the left eye. The top images show the recognition of the iris. Bottom images show the final eye location (and 2DOF rotation) estimates.

Future Evaluation of Calibration Quality



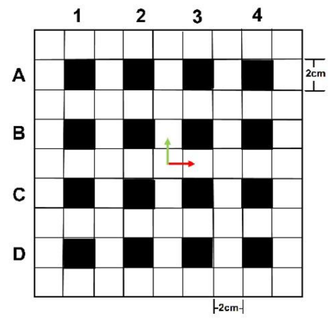


Image taken from: *K. Moser, Y. Itoh, K. Oshima, J. E. Swan, G. Klinker, and C. Sandor, "Subjective Evaluation of a Semi-Automatic Optical See-Through Head-Mounted Display Calibration Technique", IEEE Virtual Reality 2015, Arles, France, March, 2015.*