Libretracker
Free- and Open Source Eyetracking Software

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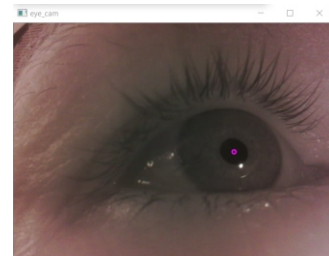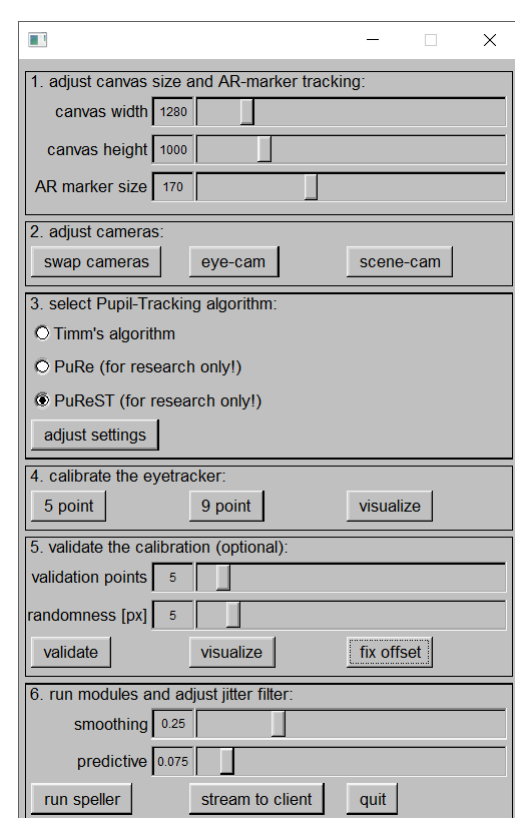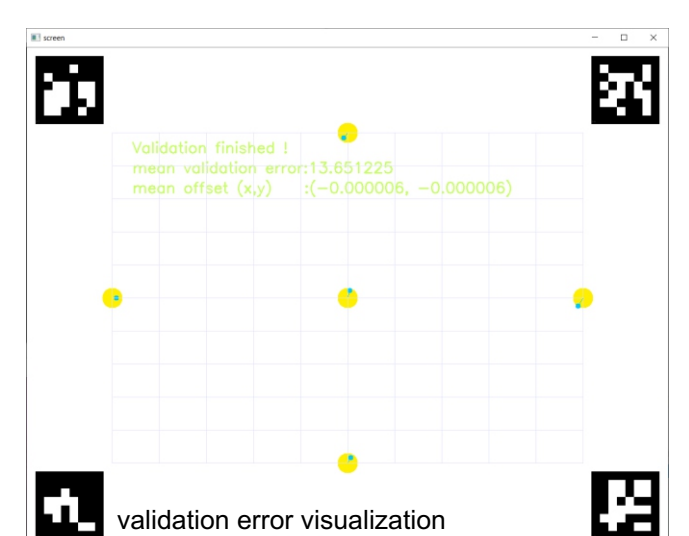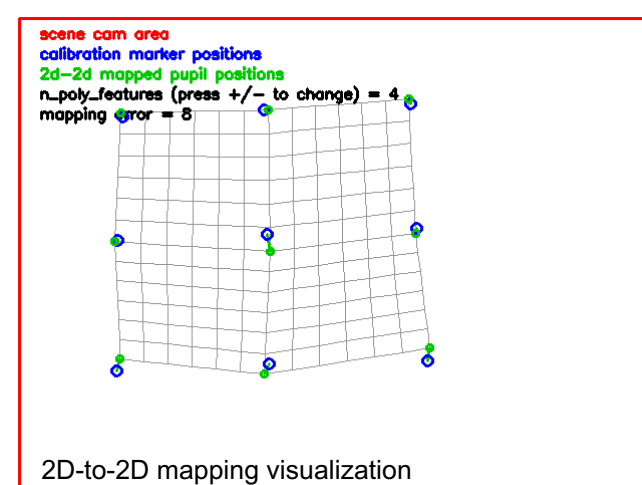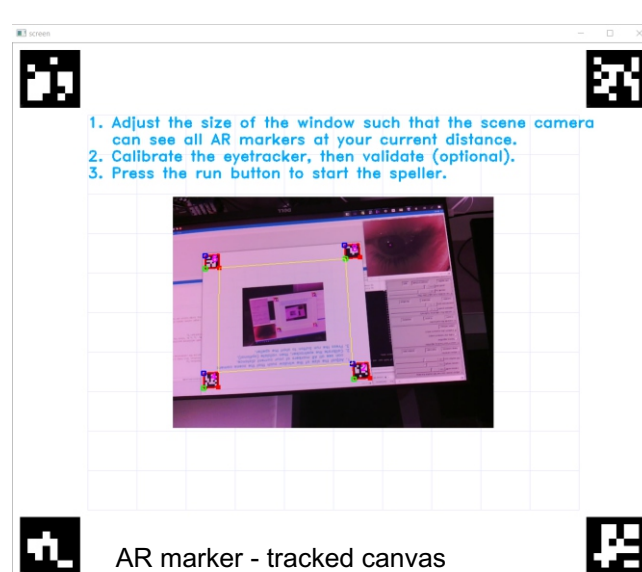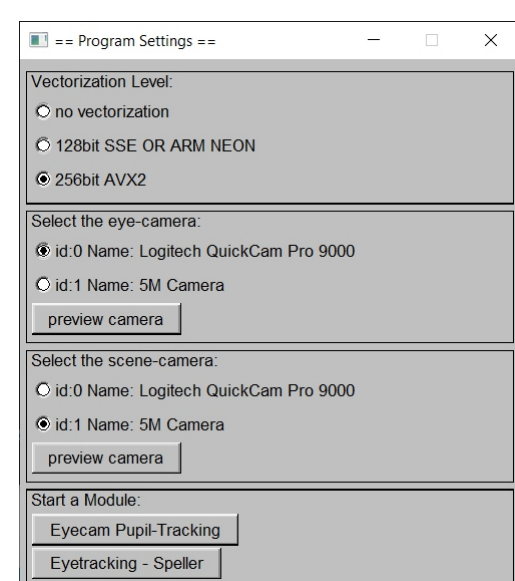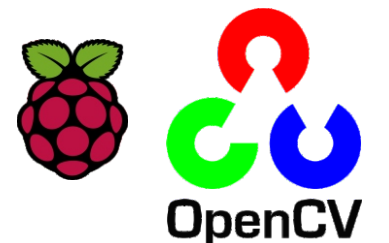
Abstract

LibreTracker is a free and open-source eyetracking software, licensed under the GPL-3. It is targeted at low-cost and do-it-yourself head-mounted Eyetrackers like the Pupil Labs headset, but works with other headsets as well. Implemented in modern C++, it has only minimal dependencies (OpenCV and the Fast Light Toolkit) and runs on many platforms (e.g. Windows, Linux and MacOS). Due to its small performance footprint, LibreTracker scales from powerful desktop workstations down to embedded devices. All USB video class compliant cameras can be used, with camera focus and exposure being adjustable for many of them. Using AR markers, the distortion of the scene camera can be evaluated, and, if necessary, calibrated. Further, we use on-screen AR markers to implement easy to use n-point calibration and scene-camera pose-estimation, such that the on-screen gaze point can be calculated regardless of head movements. For pupil-center estimation, we use a highly improved version [Krause and Essig, ETRA, 2019] of gradient based dark pupil tracking [Timm and Barth, Visapp 11, p. 125–130, 2011] that can be scaled to require less than 15ms per frame on a Raspberry Pi or less than 1ms on a Workstation. As an application scenario, we have implemented an eyetracking speller with a full virtual keyboard.
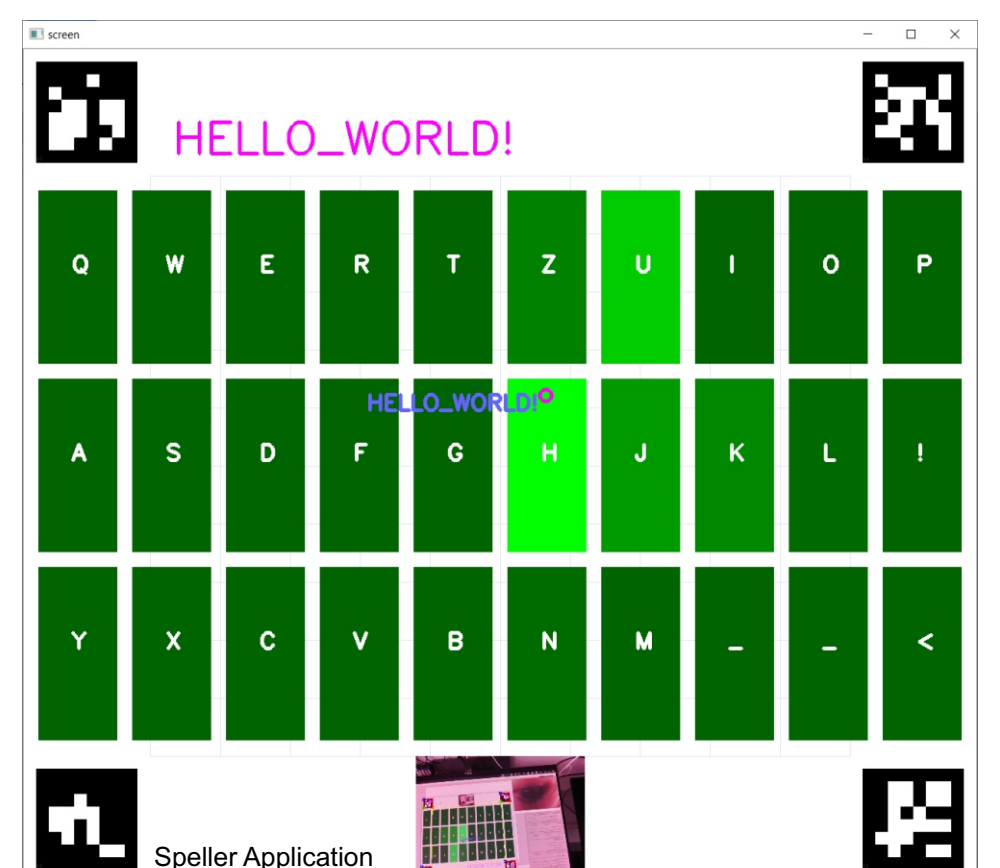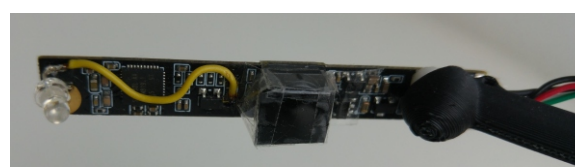
Features of Libretracker

- licensed under the GNU General Public License (GPL3)
- -> commercial usage allowed, but you must make your source code available
- works with most USB - cameras
- AR marker based calibration and screen tracking
- lightweight GUI (Fast Light Toolkit)
- runs on low-power devices like the Raspberry Pi
- built-in data-streaming using Labstreaming-Layer

Source Code available at https://github.com/afkrause/libretracker

AR marker - tracked canvas

scene cam area
calibration marker positions
2d-2d mapped pupil positions
n_poly_features (press +/- to change) = 4
mapping error = 8
2D-to-2D mapping visualization

Validation finished !
mean validation error:13.651220
mean offset (x,y)   :(-0.000006, -0.000000)
validation error visualization

HELLO_WORLD!

Q	W	E	R	T	Z	U	I	O	P
A	S	D	F	G	H	J	K	L	!
Y	X	C	V	B	N	M	_	–	<

Speller Application

Low-Cost Hardware

User-Interface and low cost Hardware

- Screenshots of the GUI show the currently implemented program functionality
- The 2d-to-2d mapping- and validation errors can be visualized
- Libretracker comes with an eyetracking speller as a sample appliction
- Low-cost hardware: the shown head-mount is mostly slip-free and can be used with glasses
- Models for 3d-printing can be found at https://github.com/afkrause/libretracker

References

Timm, F., & Barth, E. (2011). Accurate eye centre localisation by means of gradients. Visapp, 11, 125-130.

Krause, A. F., & Essig, K. (2019, June). Boosting speed- and accuracy of gradient based dark pupil tracking using vectorization and differential evolution. In Proceedings of the 11th ACM Symposium on Eye Tracking Research & Applications (p. 34). ACM.