

# pupil labs

## Product Catalog

# Hardware Overview

## Pupil Headset

Pupil Headsets are plug and play USB devices carefully designed to be lightweight, unobtrusive, and easy to use. You wear Pupil like a pair of glasses. Cameras record your field of view and your eye movements. Data is correlated with Pupil software that runs on your computer. Pupil is designed as a modular system to support the diverse needs of researchers in the fields of eye tracking, pupillometry, and egocentric vision.



Total Weight	45g
Frame Material	Laser sintered PLA
Nose Pads	Silicone nose pads can be exchanged to customize fit
Interface	Single USB C connector on collar clip (USB 2/3 compatible)

## World Camera

Sensor	2D	<a href="#">high speed</a> - 1920x1080 @30fps, 1280x720 @60fps, 640x480 @120fps <a href="#">high resolution</a> - 1910x1080 @30fps
	3D	<a href="#">3d</a> - See Intel R200 data sheet for details
Lens	2D	<a href="#">high speed</a> - Lenses are exchangeable. Hardware ships with 100 deg and 60 deg FOV lenses with M8 threads <a href="#">high resolution</a> - 90 degrees diagonal with auto focus lens.
	3D	See <a href="#">Intel R200 data sheet</a> for details
Latency	2D	5.7ms
	3D	See <a href="#">Intel R200 data sheet</a> for details

## Eye Cameras

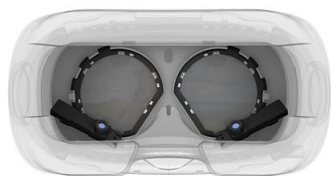
Sensor	Maximum frame rate of 200fps at 200x200 pixels with global shutter.
Illumination	IR illumination (dark pupil tracking)
Latency	4.5ms

## Operation Configurations

Direct	Pupil headsets connect directly to a computer via a single USB 2.0/3.0 cable
Mobile Device	Pupil headsets connect to an Android mobile device via a single USB C cable. Pupil Mobile Android app enables local recording and WiFi streaming of world and eye video.

# VR/AR

We have created eye tracking add-ons for the current range of leading VR and AR platforms. Our add-ons enable eye tracking without compromising your VR/AR experience. Use the VR/AR hardware you already own, and augment it with our drop-in eye tracking hardware.



## Supported Devices

HTC Vive, Oculus CV1, Oculus DK2 and HoloLens

## Basic Capabilities

Mono | Stereo

Both, depending on desired setup

Field of View

HTC Vive, Oculus CV1, Oculus DK2, HoloLens:  
up to HMD limits

Gaze Accuracy

Approx. 1.0deg

Gaze Precision

Approx. 0.08deg

## Latency

Camera Latency

4.5ms

Processing Latency

3-4ms on i5 CPU

## Eye Cameras

Frequency

HTC Vive and Oculus DK2: 120hz, HoloLens  
and Oculus CV1: 200hz

Connection

USB 2.0

Saturation

Interconnected bandwidth USB 2.0 ~60%  
saturation

## Data Output

Combined Eye Gaze

Yes

Independent Eye Gaze

Yes - 1 gaze point per eye

Pupil Position

Yes

Pupil Diameter

Yes - units in pixels using 2d appearance, units  
in mm using 3d model

Velocity | Acceleration

Can be implemented if desired

Eye Accommodation

Yes, using binocular vergence

## Calibration

Method

2D

9 points

3D

5 points

## Power Performance Memory

Host CPU % Utilization

50% of one core per eye

## Connectivity

SDK

Through network message based API

Plugin for Game Engines

Reference plugin implementation for [Unity3D](#)



# Software Overview

Pupil software runs on macOS, Linux, and Windows 10. Pupil software enables you to record, visualize, and analyze eye tracking data. Pupil software is open source and updates are released on a regular basis. Use Pupil Capture for data acquisition and real-time applications. Pupil Player for visualization and analysis (post-hoc). Pupil Mobile for data acquisition and streaming. You can easily extend functionality of Pupil by developing your own plugins in Python or modify the source code!

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[Download Software](#)

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[Pupil Mobile](#)

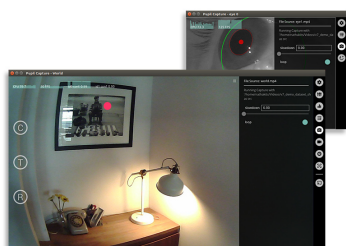
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[Documentation](#)

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## Pupil Capture

Pupil Capture is the software used with the Pupil Headset and is used to receive video and audio streams, detect your pupil, track your gaze, track surfaces in your environment, stream data in real-time over the network, and record data in an open format.



### Pupil Detection Method

Binocular, dark pupil tracking using a 3D eye model

### Calibration Procedure

Multi point calibration - 3-9 points (physical marker or on-screen marker)

### Slippage Compensation

Slippage compensation using the 3D eye model

### Pupil Diameter

Diameter is recorded in millimeters based on anthropomorphic eyeball size and in pixels based on apparent diameter

### Accuracy & Precision

2D

Accuracy : 0.6 degree of visual angle  
Precision : 0.08 degrees

3D

Accuracy : 1.4 degree of visual angle  
Precision : 0.08 degrees

### Area of Interest Tracking

Surface tracking using up to 64 unique 5x5 fiducial markers

### Multi-device Sync Synchronization

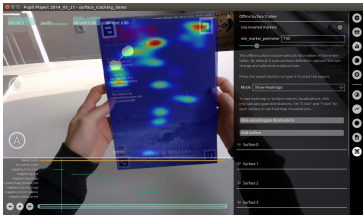
Synchronization with other Pupil devices and other sensors on a wireless/wired network

### Broadcast Pupil Data Over the Network

Real-time broadcast of Pupil data (gaze data, pupil data, events) over a wireless/wired network

# Pupil Player

Pupil Player is a media and data visualizer at its core. You will use it to look at Pupil Capture recordings. Visualize your data and export it. You can also use Pupil Player to conduct post-hoc pupil detection and calibration (gaze estimation).



## Visualization

Multiple plugins to visualize gaze data. Most visualization plugins are additive; enabling custom visualizations and analysis.

## Analysis

Fixation classification and visualization (using dispersion / duration method). Export reports of all fixations within the scene. When used in combination with Surface Tracking, export fixations on surfaces.

## Surface Tracking

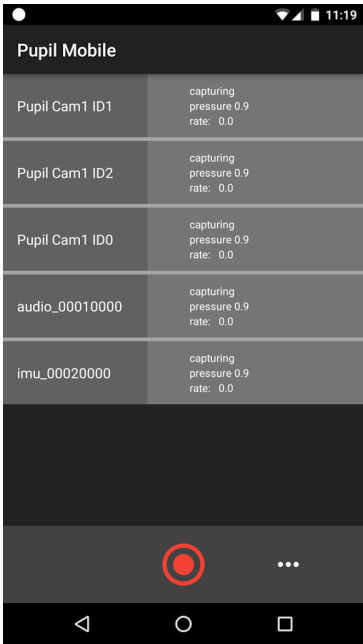
Surface tracking using up to 64 unique 5x5 fiducial markers. Edit and add surfaces based on markers in the recording. Aggregate data, generate heatmaps, and export surface data and reports.

## Export

Export videos with visualizations. Export raw data as CSV files that can be imported into a spreadsheet.

# Pupil Mobile

Pupil Mobile is a companion app to Pupil Capture and Pupil Service. The app enables you to connect your Pupil eye tracking headset to your Android device via USB-C. You can preview video and other sensor streams and record video locally on your Android device. The video data can be streamed over a WiFi network to other computers (clients) running Pupil Capture.



## Compatible Android Devices

Moto Z2 Play, Nexus 5x, Nexus 6p, and OnePlus 3 and

## Compatible Android Version

Android 7 and up

## Hardware Connection

USB-C

## Compatible Pupil Hardware

All pupil headsets except world 3D camera

## Local Recording Mode

Record up to 4 hours locally when using Pupil Labs Pupil Mobile Bundle (Moto Z2 Play with Battery Pack and SD card).

## WiFi Streaming

Pupil Mobile can stream over local WiFi network to multiple clients using the open source MDSI protocol

## Android App

Available on the [Google Play Store](#)

# Pupil Headset Configurations

## Pupil Headset

PID: pupil\_w120\_e200b\_edu



World camera: high speed 120hz world camera  
Eye cameras: 200hz binocular eye cameras  
Academic discount

World camera: [w120](#)  
Eye camera: [e200b](#)

€ 2150

## Pupil Headset

PID: pupil\_w120\_e200\_edu



World camera: high speed 120hz world camera  
Eye camera: 200hz eye camera  
Academic discount

World camera: [w120](#)  
Eye camera: [e200](#)

€ 1250

## Pupil Headset

PID: pupil\_w120\_enone\_edu



World camera: high speed 120hz world camera  
Eye camera: no eye camera  
Academic discount

World camera: [w120](#)

€ 600

## Pupil Headset

PID: pupil\_w3d\_e200b\_edu



World camera: Intel RealSense R200 RGBD Camera  
Eye cameras: 200hz binocular eye cameras  
Academic discount

World camera: [w3d](#)  
Eye camera: [e200b](#)

€ 2500

## Pupil Headset

PID: pupil\_w3d\_e200\_edu



World camera: Intel RealSense R200 RGBD Camera  
Eye camera: 200hz eye camera  
Academic discount

World camera: [w3d](#)  
Eye camera: [e200](#)

€ 1600

## Pupil Headset

PID: pupil\_w3d\_enone\_edu



World camera: Intel RealSense R200 RGBD Camera  
Eye camera: no eye camera  
Academic discount

World camera: [w3d](#)

€ 950

### Pupil Headset

PID: pupil\_w30\_e200\_edu



World camera: high resolution 30hz world camera  
Eye camera: 200hz eye camera  
Academic discount

World camera: [w30](#)  
Eye camera: [e200](#)

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€ 1250

### Pupil Headset

PID: pupil\_w30\_enone\_edu



World camera: high resolution 30hz world camera  
Eye camera: no eye camera  
Academic discount

World camera: [w30](#)

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€ 600

### Pupil Headset

PID: pupil\_wnone\_e200b\_edu



World camera: no world camera  
Eye cameras: 200hz binocular eye cameras  
Academic discount

Eye camera: [e200b](#)

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€ 1900

### Pupil Headset

PID: pupil\_wnone\_e200\_edu



World camera: no world camera  
Eye camera: 200hz eye camera  
Academic discount

Eye camera: [e200](#)

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€ 1000

# VR/AR

## HoloLens Binocular Add-on

PID: hololens\_w120\_e200b



Microsoft HoloLens eye tracking add-on with 2 x 200hz eye cameras and 1 x high speed world camera.

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€ 1750

## HTC Vive Binocular Add-on

PID: htcvive\_e120b



HTC Vive eye tracking add-on with 2 x 120hz eye cameras.

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€ 1400

## Epson BT300 Add-on

PID: epsonbt300\_w120\_e200b



Epson Moverio BT300 eye camera mounts, USBC clip, cable harness, binocular 200hz eye cameras, high speed world camera.

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€ 1750



## Additional Products

Here you will find upgrades for existing Pupil hardware and additional products like Pupil Mobile.

### Eye Camera

PID: camera\_e200



200hz eye camera upgrade

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€ 650

### Pupil Mobile Bundle

PID: pm\_motoz3



Moto Z3 Play (blue), hot-swappable Moto power pack, 64gb SD card, USBC-USBC cable, and is pre-loaded with the Pupil Mobile app. Connects to Pupil headset via USBC cable (included).

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€ 750

### USB-C Upgrade

PID: hub\_usbc



Upgrade any existing Pupil headset with the new USB-C clip. Comes with USB-C to USB-A cable.

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€ 210

### Support Contract

PID: support\_6



6 month support contract. 3 one hour video support sessions and email support.

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€ 1000

### Support Contract

PID: support\_12



12 month support contract. 7 one hour video support sessions and email support.

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€ 2000

# Camera Specs

Pupil cameras are custom built by Pupil Labs. The fastest, smallest, lightest, most versatile, and resolve a wide range of eye movement motifs.

## World cameras

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### high speed

PID: w120

World camera custom built by Pupil Labs. The fastest, smallest, lightest, and most versatile world camera in our product line. We recommend this option for most research use cases.

Sensor	Latency	FOV	Audio
1920x1080 @30fps, 1280x720 @60fps, 640x480 @120fps. Sensor model OV2710.	5.7ms	100 degrees diagonal. Lenses are exchangeable: Headset ships with 60deg and 100 deg FOV lenses.	Record audio via host device microphone

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### 3d

PID: w3d

Intel RealSense R200 RGBD camera. Provides depth image and monocular RGB color image. (Note: This sensor is not compatible with Pupil Mobile).

Sensor	Latency	FOV	Audio
See <a href="#">Intel R200 data sheet</a> for details	See <a href="#">Intel R200 data sheet</a> for details	See <a href="#">Intel R200 data sheet</a> for details	Record audio via host device microphone

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### high resolution

PID: w30

World camera with beautiful image quality and stereo microphones. We recommend this option when you want aesthetically pleasing footage and on-board microphones, and are not concerned with size, weight, or speed.

Sensor	Latency	FOV	Audio
1910x1080 @30fps	127.7ms	90 degrees diagonal with auto focus lens.	Record audio with built-in stereo microphone

# Eye cameras

## 200hz binocular

PID: e200b

Eye cameras custom built by Pupil Labs. Our smallest, lightest, and fastest eye tracking cameras. Global shutter and 200hz speed enable robust pupil detection and eye movement motif classification

Sensor	Latency	Illumination
Global Shutter. 192x192 @ 30fps, 60fps, 90fps, 120fps, 180fps, 200fps 400x400 @ 30fps, 60fps, 90fps, 120fps, 200fps	4.5ms	IR camera with IR illumination and IR bandpass filter (dark pupil tracking)

## 200hz

PID: e200

Eye camera custom built by Pupil Labs. Our smallest, lightest, and fastest eye tracking camera. Global shutter and 200hz speed enable robust pupil detection and eye movement motif classification.

Sensor	Latency	Illumination
Global Shutter. 192x192 @ 30fps, 60fps, 90fps, 120fps, 180fps, 200fps 400x400 @ 30fps, 60fps, 90fps, 120fps, 200fps	4.5ms	IR camera with IR illumination and IR bandpass filter (dark pupil tracking)