



Ergoneers
Ergonomic Engineers



Dikablis Glasses & D-Lab Eye-Tracking

1. Overview D-Lab Measurement & Analysis Solution
2. Dikablis Glasses
3. D-Lab Eye-Tracking Software
4. Outlook



1. Overview

Overview

Sensors



DataStream:

- Network
- CAN
- Fieldbus



Videos:

- PAL
- IP
- IP PTZ
- DVI



Eye-Tracking:

- Head-Mounted
- HMD



Audio



Physiology



Motion



D-Lab



Process
Software

Plan

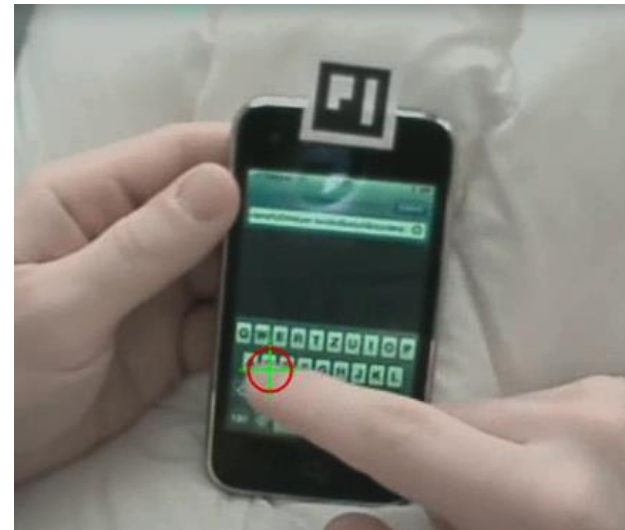
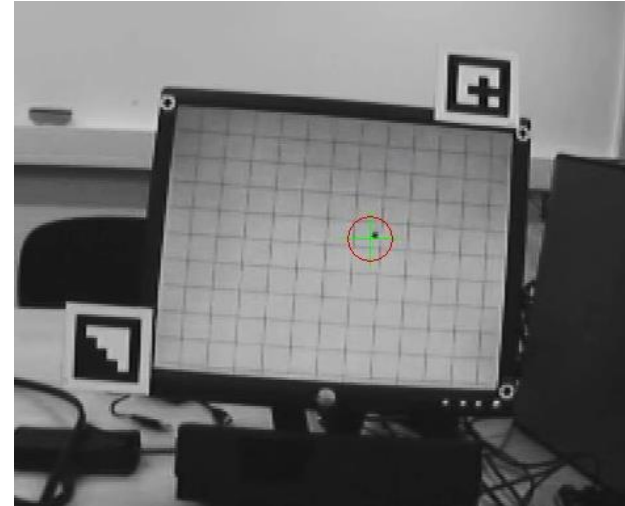
Measure

Analyze

2. Dikablis Glasses

Dikablis Glasses

- Dikablis Glasses
 - Cable
 - Mobile
 - Wireless
- Tracking frequency: 50Hz
- Weight: 69g
- Accuracy:
 - Pupil detection: $0,1^\circ$
 - Glance direction: $0,3^\circ - 0,5^\circ$
- Camera viewing angle: $45^\circ - 120^\circ$
- Portable with:
 - Normal glasses
 - Shutter glasses
 - Polarized glasses



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 - Polarized glasses
- Hardware Development Kit covers all other cases (e.g. HMD integration)



Dikablis Glasses - Versions

Dikablis Cable

- Mobility: 50m
- Data-Transmission via Cable
- Live View & Real-time & Offline access to data

Dikablis Mobile

- Mobility: unlimited
- Data is recorded on 11" laptop
- Real-time & Offline access to data
- Battery life: 3h

Dikablis Wireless

- Mobility: up to 500m
- Data-Transmission via wireless digital radio communications
- Live View & Real-time & Offline access to data
- Battery life: 2,5h



3. D-Lab Eye-Tracking Software

Changing Lighting Conditions

Hardware:

- 11mm thick bandpass filter in front of eye-camera
- Perfect adjustment between:
 - Band of the bandpass filter
 - IR illumination
 - Sensitivity of eye-camera chip

Software:

- Blending Mode
- All raw data is stored (videos of field-camera and eye-camera)
- Allows:
 - Control of pupil detection
 - Offline pupil detection

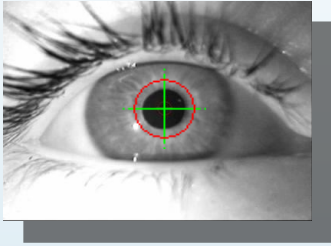
Result:

- Data can always be analyzed under all kinds of conditions
- No data has to be thrown away



Coordinate Systems

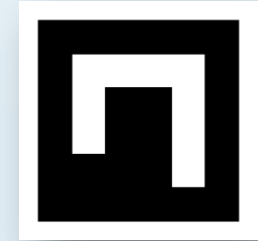
Pupil detection – eye-cam coordinates



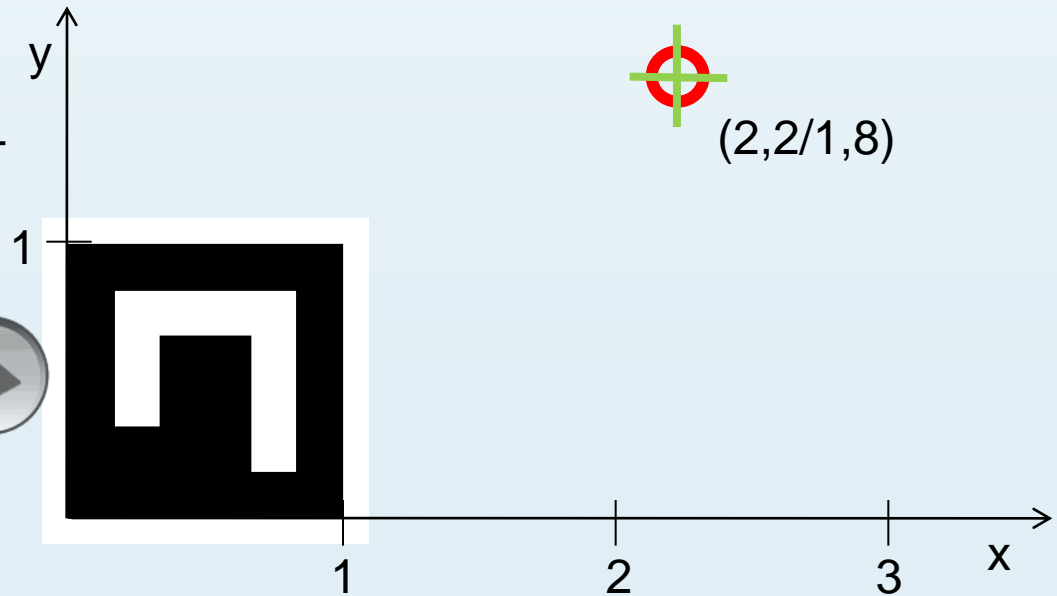
Fixations in field-cam coordinates



Marker detection

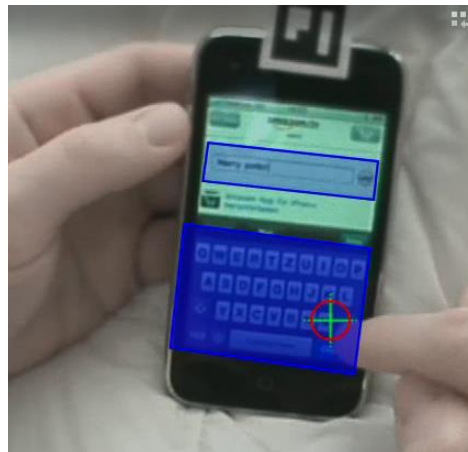


- Transformation from fixations in field-cam coordinates in marker coordinates
- Fixation in all marker coordinate systems
- Allows design of eye-controlled interaction with any kind of devices



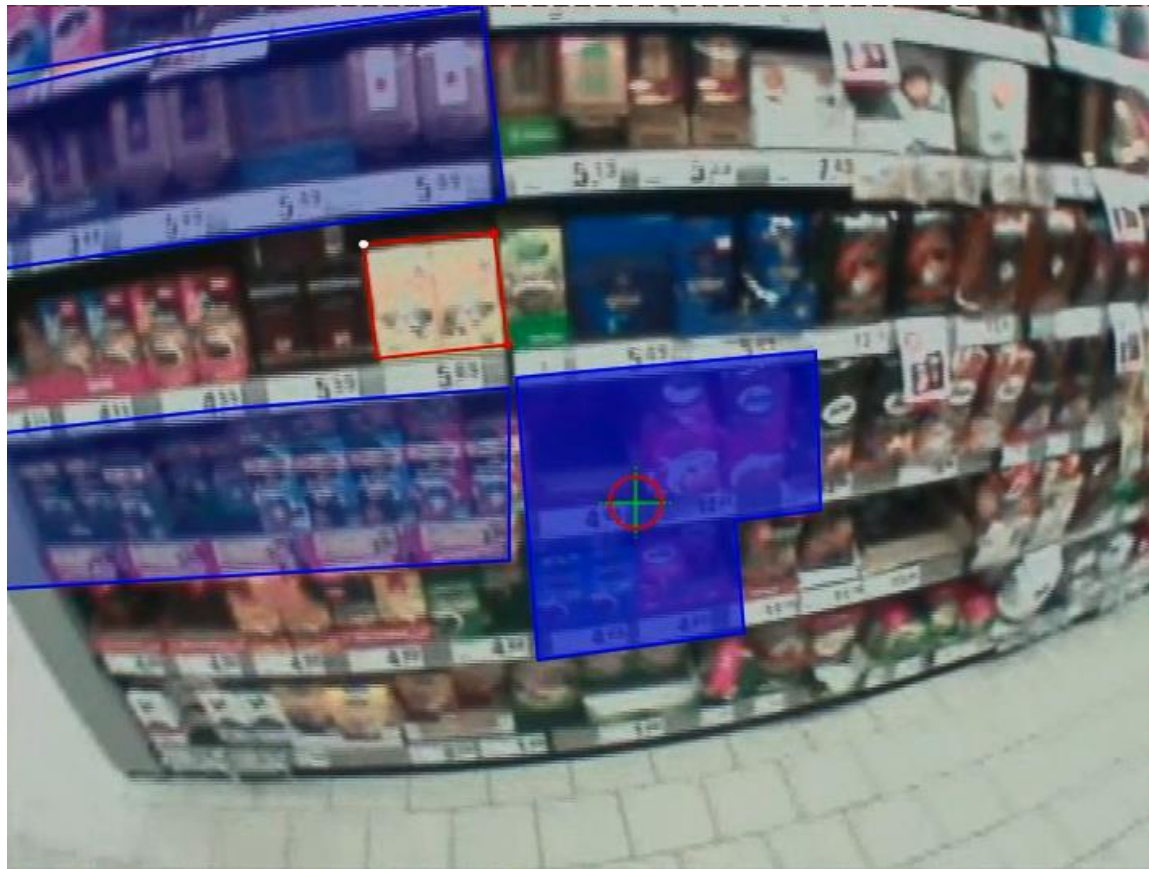
Data Analysis – Marker-based

- D-Lab detects markers and uses them as a reference
- Markers can be attached in the environment (static) or at dynamically moving AOIs
- One can define an unlimited number of AOIs of any shape per Marker
- D-Lab analyzes automatically glances towards defined AOIs



Data Analysis – SmartTrack

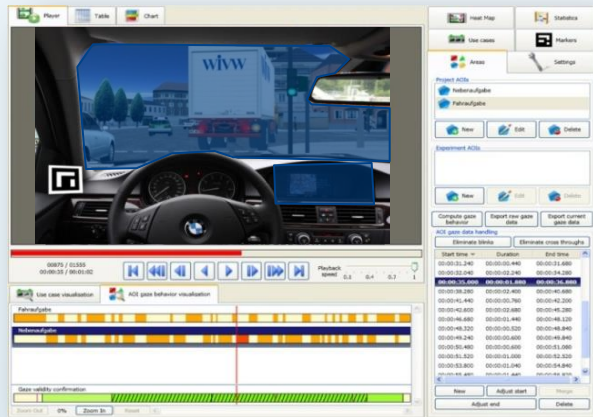
- D-Lab detects natural objects (static or dynamic) and uses them as markers
- AOIs can be defined relative to these markers (by drawing polygons)
- D-Lab analyzes automatically glances towards defined AOIs



Data Analysis – Workflow and Metrics

AOI Definition and calculation of glance durations

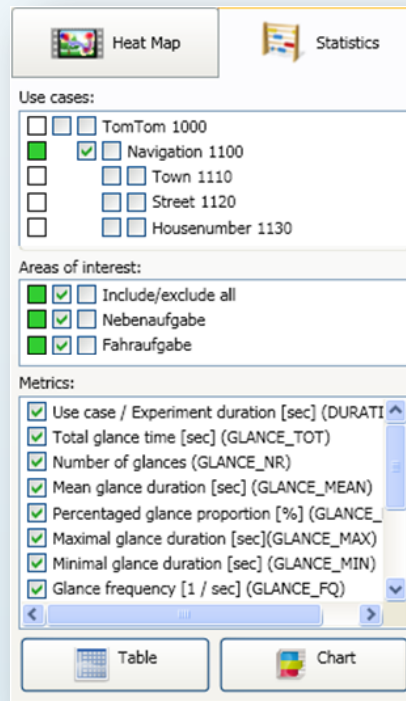
- AOIs of any shape can be defined
- Glance durations are calculated automatically
- Glance durations are visualized as timeline bars and in a list



Statistical Analysis

Define rules for the Calculation of Glance Metrics:

- Select Task Intervals
- Select Areas of Interest
- Select Metrics (glance based and pupil based)

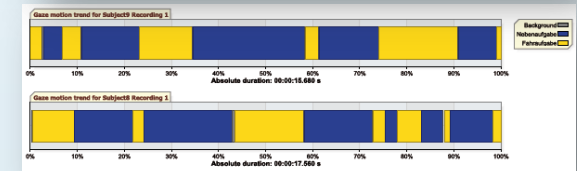
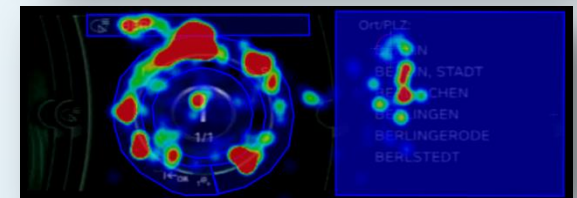


The screenshot shows the 'Statistics' configuration window. It has two tabs: 'Heat Map' and 'Statistics'. The 'Statistics' tab is active, showing a 'Use cases:' section with checkboxes for 'TomTom 1000', 'Navigation 1100', 'Town 1110', 'Street 1120', and 'Housenumber 1130'. The 'Areas of interest:' section has checkboxes for 'Include/exclude all', 'Nebenaufgabe', and 'Fahraufgabe'. The 'Metrics:' section has checkboxes for 'Use case / Experiment duration [sec] (DURATI)', 'Total glance time [sec] (GLANCE_TOT)', 'Number of glances (GLANCE_NR)', 'Mean glance duration [sec] (GLANCE_MEAN)', 'Percentage glance proportion [%] (GLANCE_...', 'Maximal glance duration [sec](GLANCE_MAX)', 'Minimal glance duration [sec] (GLANCE_MIN)', and 'Glance frequency [1 / sec] (GLANCE_FQ)'. At the bottom, there are 'Table' and 'Chart' buttons.

Visualization of Results

- Tables with Metrics and Descriptive Statistics are automatically created
- Graphical visualization as GazeFlow Diagrams and HeatMaps

TEST_PERSON	1100_DURATION	1100_NEBENAUFGABE_GLANCE_TOT	1100_NEBENAUFGABE_GLANCE_NR	1100_NEBE
Subject9_Recording	56.64	32.64	23	1.419
Subject8_Recording	49.28	33.72	28	1.533
Subject7_Recording	65.96	46.96	28	1.677
Subject6_Recording	91.8	46.8	30	1.56
Subject5_Recording	78.36	42.64	27	1.579
Subject4_Recording	79.08	38.08	27	1.41
Subject3_Recording	84.4	51.36	31	1.657
Subject2_Recording	55.44	35.16	22	1.598
Subject12_Recording	84.4	55.56	39	1.425
Subject11_Recording	57.68	34.12	20	1.706
Subject10_Recording	60.64	40.28	27	1.492
Subject1_Recording	140.12	87	47	1.851
Sum	903.8	544.32	343	18.907
Mean	75.317	45.36	28.583	1.576
Max	140.12	87	47	1.851
Min	49.28	32.64	20	1.41
StDev	24.671	15.063	7.716	0.133
Var	608.675	226.585	59.538	0.018



4. Outlook

Dikablis Glasses

- New Dikablis SmartGlasses in January 2014:
 - New Design in Google Glasses Style
 - HD FieldCamera
 - Monocular/Binocular Eye-Tracking with 120Hz
- New Dikablis HRGlasses in July 2014:
 - FullHD FieldCamera
 - Binocular 250Hz

D-Lab Software:

- Continued integration of 3rd Party sensors and related methods
(e.g. Remote Eye-Tracker, GPS, Motion Capturing, Physiology, etc.)
- Scripting language (realtime and offline)



Thank you!

D-Lab 3.0 - Demo

Main View Study Design Record & Play Dikablis Data Stream Video Physio Data

Windows 8 Bring to Main Save Load

Theme Layout

Visualizations: Grid, Line Chart, Peak Gauge, Point Chart, Round Gauge, Semicircle Gauge, State Diagram, Step Line Chart, Value

AOI Management

AOIs

Color	Name	Scope	Calibration Plane
Blue	Fahrplan	Study	Original
Yellow	Tacho	Study	Original

AOIs Set

Glance Behavior

Entire Study

Data Session

Calculate Glances Eliminate Blinks Eliminate Fly Through

Manual Glances

New Start End Delete

Glance Durations

Start time	Duration	End time
00:00:26.271	00:00:00.360	00:00:26.631
00:00:27.191	00:00:01.160	00:00:28.351
00:00:29.111	00:00:01.520	00:00:30.631
00:00:31.151	00:00:01.600	00:00:32.751
00:00:33.791	00:00:01.280	00:00:35.071
00:00:36.311	00:00:01.880	00:00:38.191
00:00:39.031	00:00:01.400	00:00:40.431
00:00:41.551	00:00:01.560	00:00:43.111
00:00:43.751	00:00:01.760	00:00:45.511

Study Explorer

Name Sources


- Demo
 - Male
 - Christian
 - 2. Session: 31.05.2013 14:13:22
 - Johann
 - 2. Session: 31.05.2013 13:12:39
 - Roland
 - 2. Session: 31.05.2013 13:58:17

Data Session Explorer

Name	Type	Visualizations
3_*767108*	Fahrzene	
4_*767108*	FuBraum	
SimLab Konfiguration		
Index	Real	
Steering wheel angle	Real	Semicircle Ga
Revolutions per minute	Real	Peak Gauge
Speed km/h	Real	
Speed m/s	Real	
Acceleration m/s^2	Real	Brake Pedal, B
Lateral speed m/s	Real	
Lateral acceleration m/s^2	Real	
Time to Lane Change (TLC)	Real	
Time To Collision (TTC)	Real	

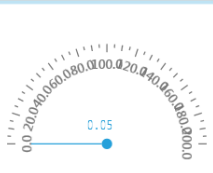
Task Explorer Data Session Explorer Notes

Brake Pedal, Brake within 500ms, Acceleration m...

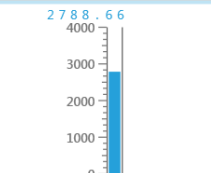


Settings


Semicircle Gauge



Peak Gauge



Eye Tracking



Pupil detected!

Glance Time Lines

Fahrplan

Tacho

Is Timeline Zoom Enabled

Tasks Time Glance Time Lines

Playback

00:00:00.000 00:03:36.484 00:02:10:549 00:08:50.328

00:02:30.000 00:03:00.000 00:03:30.000 00:04:00.000 00:04:30.000