



eGlasses - The interactive eyeglasses

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Presentation plan

- Project title, project start date
- Scientific background and objectives of the project
- Presentation of the consortium: introduction of each partner
- Presentation of the workplan
- Elements on project management
- Early results
- Valorisation

The project title:

***eGlasses - The interactive eyeglasses for mobile,
perceptual computing***

Time period:

01.01.2014, 36 months

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The eGlasses project is focused on:

1. the development of an open platform in the form of modular, multisensory electronic glasses, and
2. the integration and designing of new intelligent interaction methods using the eGlasses platform.

ARDUINO-like eGlasses

The main scientific and technological objectives are to design and evaluate the following:

- eye-tracking hardware and algorithms for a user, who is mobile in a noisy real world environment,
- algorithms for perceptual media and for super perceptual computing,
- methods of interactions with users and objects (menu of activities for the identified person or object),
- an interface in a form of a peripheral proximity radar,
- methods for the recognition of the user's own gestures and recognition of gestures of the observed person,
- methods for context-aware behavioural studies,
- methods for reference applications.

The verification of the new intelligent user interface will be performed using three usage scenarios:

- as a tool for a Health professional - screening/evaluation tool (heart rate from the face skin, remote measurements of face skin temperature, dynamics of face muscles – e.g. stroke, etc.); especially for nurses, members of emergency teams, etc.;
- as an assistant tool for disabled users (proximity radar, haptic interface to protect the head, colour recognition and identification for colour-blinded, etc.)
- as a tool for behavioural analysis (analysis of a person's activity in reference to their environment, e.g. eye-tracking vs. observations, response to the perceptual events, etc.). - methods for reference applications.

Presentation plan

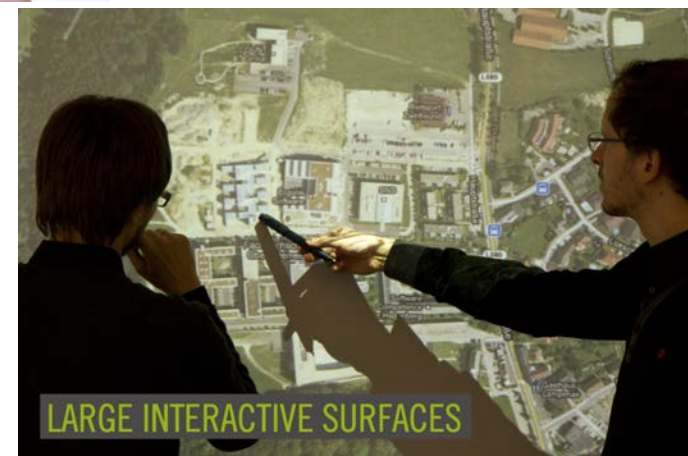
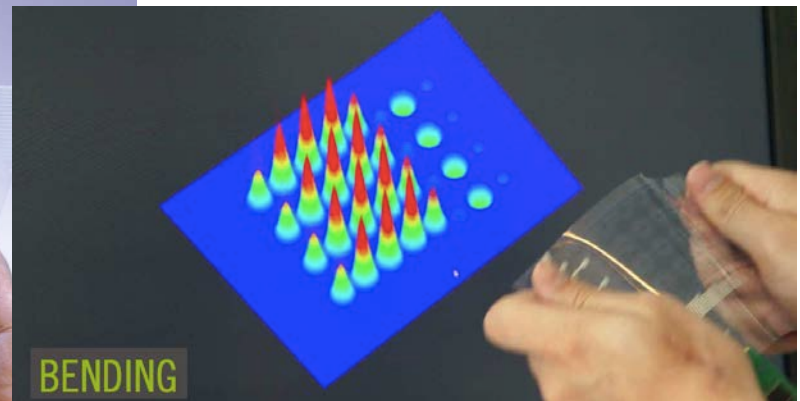
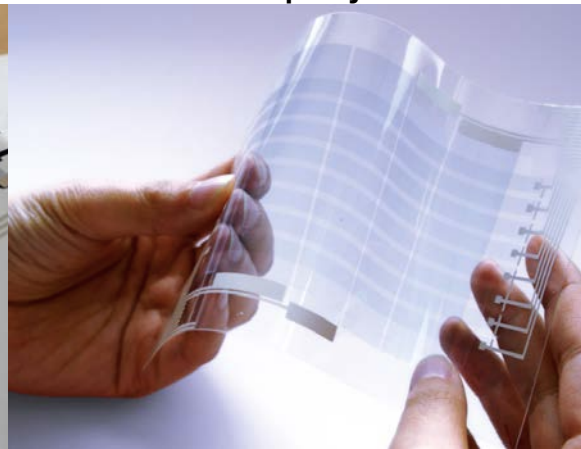
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Consortium

1 <i>Coordinator</i>	PL	Gdansk University of Technology, Faculty of Electronics Telecommunications and Informatics, Department of Biomedical Engineering (GUT/DBME)
2	AT	University of Applied Sciences Upper Austria / Media Interaction Lab (MIL)
3	CH	Hochschule Luzern / iHomeLab
4	FR	University of Lorraine / Laboratory of Conception, Optimization, and Modelling of Systems (LCOMS)
5	LU	University of Luxembourg / Interdisciplinary Centre for Security, Reliability and Trust (UL/SnT)

Partner: Media Interaction Lab

The Media Interaction Lab is a research lab hosted at the Department of Interactive Media at the University of Applied Sciences Upper Austria | School of Informatics, Communication and Media in Hagenberg. The Media Interaction Lab integrates research and education, providing students with a project-based learning environment.



The eGlasses consortium receives the funding support of NCBiR, FWF, SNSF, ANR, and FNR in the framework of the ERA-NET CHIST-ERA II.

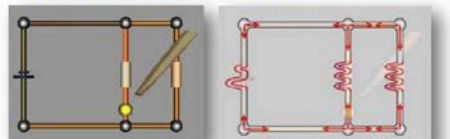
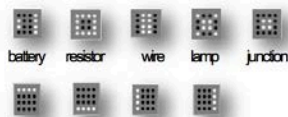
Partner: LCOMS : Laboratory of Conception, Optimization, and Modelling of Systems, Universite de Lorraine

LCOMS is a multidisciplinary laboratory focused on the research and education in fields of Automatics, Computer science, Electronics, Science of sport activities. Two teams of the LCOMS participate in the project: IHM – Human/Computer Interaction, and EPSAP: Assistive technology and performance evaluation.

Haptics for visually impaired users

Collaborative multimodal environment

- MICOLE (European project)
 - 09/2004 to 08/2007
- Visually impaired children and electrical circuits
- Haptic language : tactile and force feedbacks



Motor impairment : Mobility

To help steering electric wheelchairs

Intelligent Wheelchair

- Deictic control,
- Haptic feedback

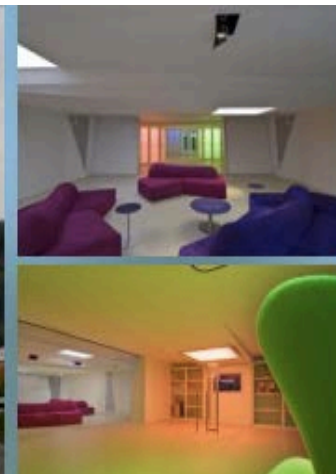
Driving simulator



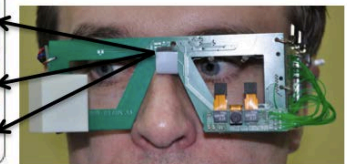
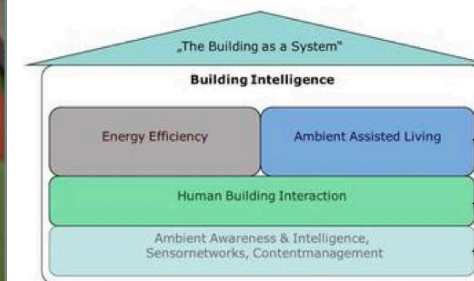
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Partner: iHomeLab

The iHomeLab is the Swiss think tank for Building Intelligence. Key research aspects of the iHomeLab are energy efficiency, comfort, and safety; special attention is given to the issue of ambient assisted living and human building interaction. The iHomeLab Living Lab is also a network platform with international impact, where the latest results of joint venture research projects are presented and discussed with experts and wide public.



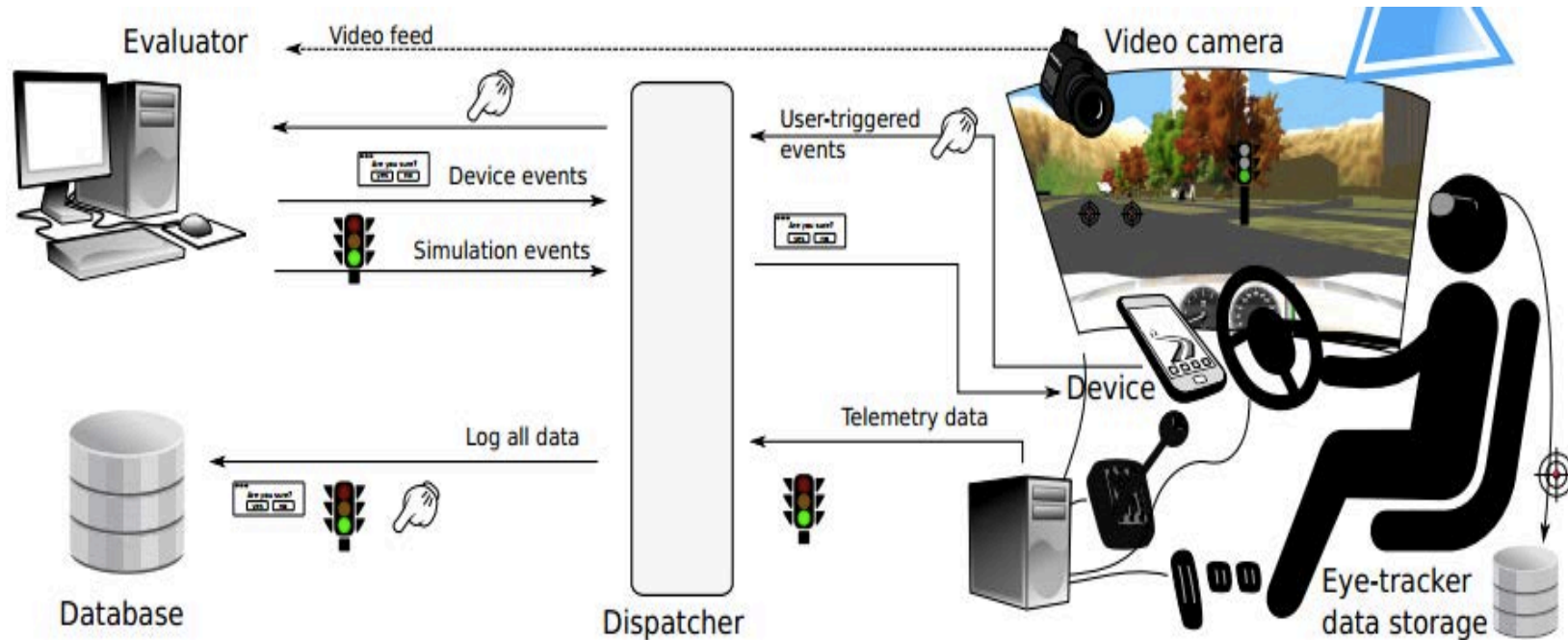
The intelligent building will be used for evaluation and tests of the eGlasses platform and related interaction techniques



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Partner: University of Luxembourg / Interdisciplinary Centre for Security, Reliability and Trust (UL/SnT)

UL/SnT has extensive facilities and experience for conducting human-factors related research. On going research in the IGEAR project explores serious games and multimodal interfaces (including eye-tracking) for use in cars. These can be also used for development and evaluation of the eGlasses platform and new interaction techniques developed for the eGlasses



Partner: Department of Biomedical Engineering, Faculty of Electronics, Telecommunications and Informatics, Gdansk University of Technology

GUT/DBME has an experience in biomedical engineering, computer engineering, electronics and automatics. The teams of the department are working in the area of fundamental research and applied research. DBME has several laboratories that enable to construct and verify technological innovations (sensors, electronic circuits, telecommunication solutions, etc.). It also includes certified equipment to perform biomedical measurements (e.g. ECG, EEG, SpO2, clinical spirometers, etc.) that can be used for validation of the super-perceptual processing methods.



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The list of work packages is given below:

WP1 – *Project management*

WP2 – *Requirement analysis and the design of the eGlasses platform*

WP3 – *Development of the eGLASSES core platform*

WP4 – *Development of input/output extensions for the eGLASSES: an eye gaze-tracking module, a micro display and a proximity radar*

WP5 – *Development, implementation and evaluation of algorithms for recognition of the user's own gestures and recognition of gestures of the observed person*

WP6 – *Development, implementation and evaluation of reference applications – the healthcare professional assistant*

WP7 – *Development, implementation and evaluation of reference applications – the assistant tool for the disabled and the tool for context-aware behavioural studies*

WP8 – *Dissemination and Exploitation*

				Year 1												Year 2												Year 3																								
Id	Tasks	Start	End	PM	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12												
WP1	Project management	M1	M36	16.83																																																
T1.1	Project Coordination and Management	M1	M36																																																	
T1.2	Quality Assurance	M1	M36																																																	
T1.3	Project Communication	M1	M36																																																	
WP2	Requirement analysis and the design of the eGlasses platform	M1	M4	9																																																
T2.1	Investigation and analysis of overall requirements	M1	M2																																																	
T2.2	The eGlasses hardware requirement specification	M2	M4																																																	
T2.3	Specification of evaluation criteria	M2	M4																																																	
WP3	Development of the eGLASSES core platform	M3	M24	34.5																																																
T3.1	The design and implementation of a MCU-based board	M3	M16																																																	
T3.2	The design and implementation of the extensions board	M4	M16																																																	
T3.3	The design and implementation of the front panel with embedded sensors and extensions	M4	M16																																																	
T3.4	The software API for the core platform	M7	M17																																																	
T3.5	Simulator Platform Development	M3	M12																																																	
T3.6	The evaluation of the core platform	M9	M24																																																	
	Development of input/output extensions for the eGLASSES: an eye gaze-tracking module, a micro display and a proximity radar	M4	M28	33																																																
T4.1	Development of hardware standard extensions and interfaces	M4	M18																																																	
T4.2	Development and implementation of algorithms for the extensions	M5	M20																																																	
	Development and implementation of algorithms for data integration and reasoning	M5	M20																																																	
T4.4	Evaluation of the software/hardware extensions	M10	M28																																																	
	Development, implementation and evaluation of algorithms for recognition of the user's own gestures and recognition of gestures of the observed person	M2	M30	47																																																
T5.1	Understanding gestures	M2	M6																																																	
T5.2	Specification of a mid-air gesture library	M6	M12																																																	
T5.3	Implementation of gesture-based interaction techniques & feedback language	M12	M20																																																	
T5.4	Evaluation of the mid-air gesture library	M18	M30																																																	
	Development, implementation and evaluation of reference applications – the healthcare professional assistant	M3	M34	39																																																
T6.1	Requirements capture	M3	M6																																																	
	Development and implementation of algorithms for the identification of a patient	M6	M12																																																	
T6.3	Development and implementation of algorithms for estimation of physiological parameters from video sequences	M6	M18																																																	
T6.4	Development and implementation of algorithms for integrated data measurements, analysis and visualization	M10	M24																																																	
T6.5	Evaluation and user tests of the new interaction techniques	M22	M34																																																	
	Development, implementation and evaluation of reference applications – the assistant tool for the disabled and the tool for context-aware behavioral studies	M4	M34	43.67																																																
T7.1	Requirements capture	M4	M7																																																	
	Development and implementation of algorithms for the automatic recognition of devices and interaction with them	M6	M12																																																	
T7.3	Development and implementation of algorithms for the identification of colours	M6	M9																																																	
	Development and implementation of algorithms for context-aware behavioural studies	M6	M20																																																	
T7.5	Development and implementation of algorithms for locating objects and guiding vision towards the identified objects	M8	M14																																																	
T7.6	Evaluation and user tests of the new interaction techniques	M16	M34																																																	
WP8	Dissemination and Exploitation	M1	M36	15																																																
T8.1	Plan for the Use and Dissemination of Results	M1	M4																																																	
T8.2	Monitoring of the results and protection of project results	M2	M36																																																	
T8.3	Dissemination of project results	M2	M36																																																	

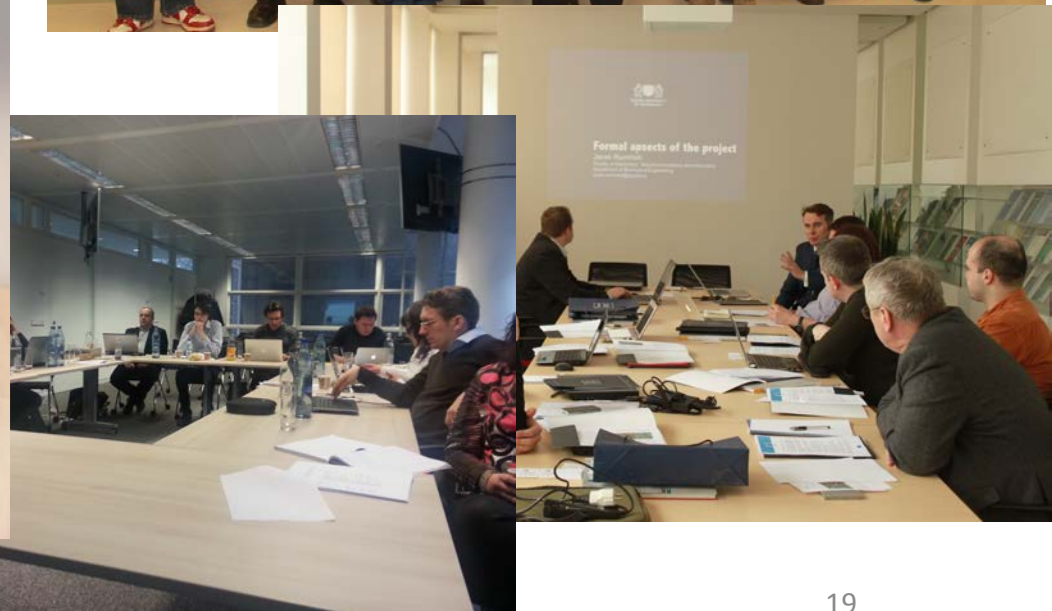
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Consortium meetings and seminars

1. *Gdansk, 6-7 February, 2014.*
2. *Luxembourg, 29-30 January, 2015.*

- a. Many Skype meetings and email-based discussions.
- b. Meetings during conferences.
- c. Bilateral visits.



Budget

During the first year of the project 3 partners used about 1/3 of their budget. Other two partners used only 10% of budget, but their main involvement in project activities will be in the following two years (2015, 2016).

N°	Partner	Person.months	Total costs	Percentage of requested budget
1	Gdansk University of Technology	27.07	136863.17 Euro	35.2%
2	University of Applied Sciences Upper Austria	12	61434,73 Euro	30.19%
3	Hochschule Luzern	1.84	16498 Euro	10%
4	University of Lorraine	0 (8)	8342,5 Euro	10,69%
5	University of Luxembourg	11.06	81830 Euro	34%

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Publications

The objectives of the eGlasses project primarily relate to the development on new interaction approaches, which are based on the eyewear platform being developed.

Therefore, **during the first year** of the project only limited publications were prepared.

Journals: *1 accepted*

Conferences: *6 published*

Technical Reports: *1 published*

Deliverables (reports): *17 published (about 500 pages)*

Currently, we have about 15 papers prepared for publication in 2015.

WP2 Requirement analysis and the design of the eGlasses platform

All tasks have been completed. As a result 9 reports (*217 pages*) were prepared:

D2.1: Specification of overall requirements and updated state of the art and future challenges – a report (*21 pages*)

D2.2: The eGlasses hardware requirement specification – a report (*31 pages*)

D2.2.1: Electronic eye-wear platforms (*33 pages*),

D2.2.2: Mobile microprocessor and boards (*46 pages*),

D2.2.3: Eye-tracking-review (*18 pages*),

D2.2.4: Image presentation techniques in Near to Eye displays (*16 pages*),

D2.2.5: Proximity radars (*32 pages*),

D2.3: Evaluation criteria and scenarios – a report (*11 pages*)

D2.3.1: The catalogue of planned tests D2.3.1 (*19 pages*)

All partners have participated in tasks.

WP3 Development of the eGLASSES core platform (hardware and software) – 31.12.2015

The most important part of this WP in the first year was **The design and implementation of a MCU-based board (Task 3.1, D3.1) – successfully completed.**

The board was designed to support easy modification, for example changing the processor should not require major changes to the board.

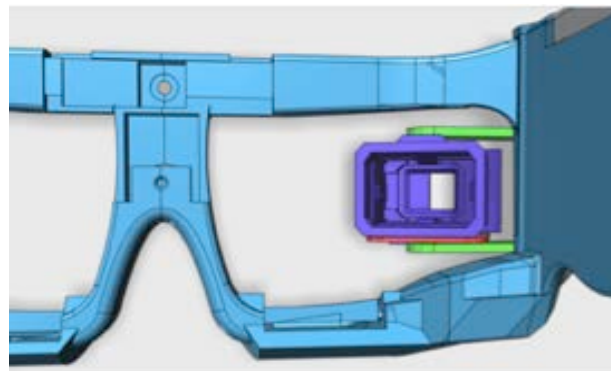
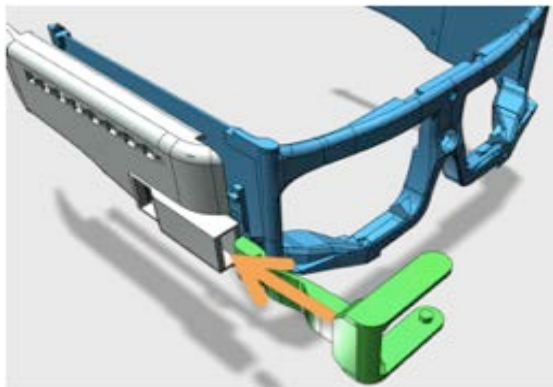
Two boards have been designed: for TI OMAP processors and for the Exynos processor. Other processors can be introduced in the future.

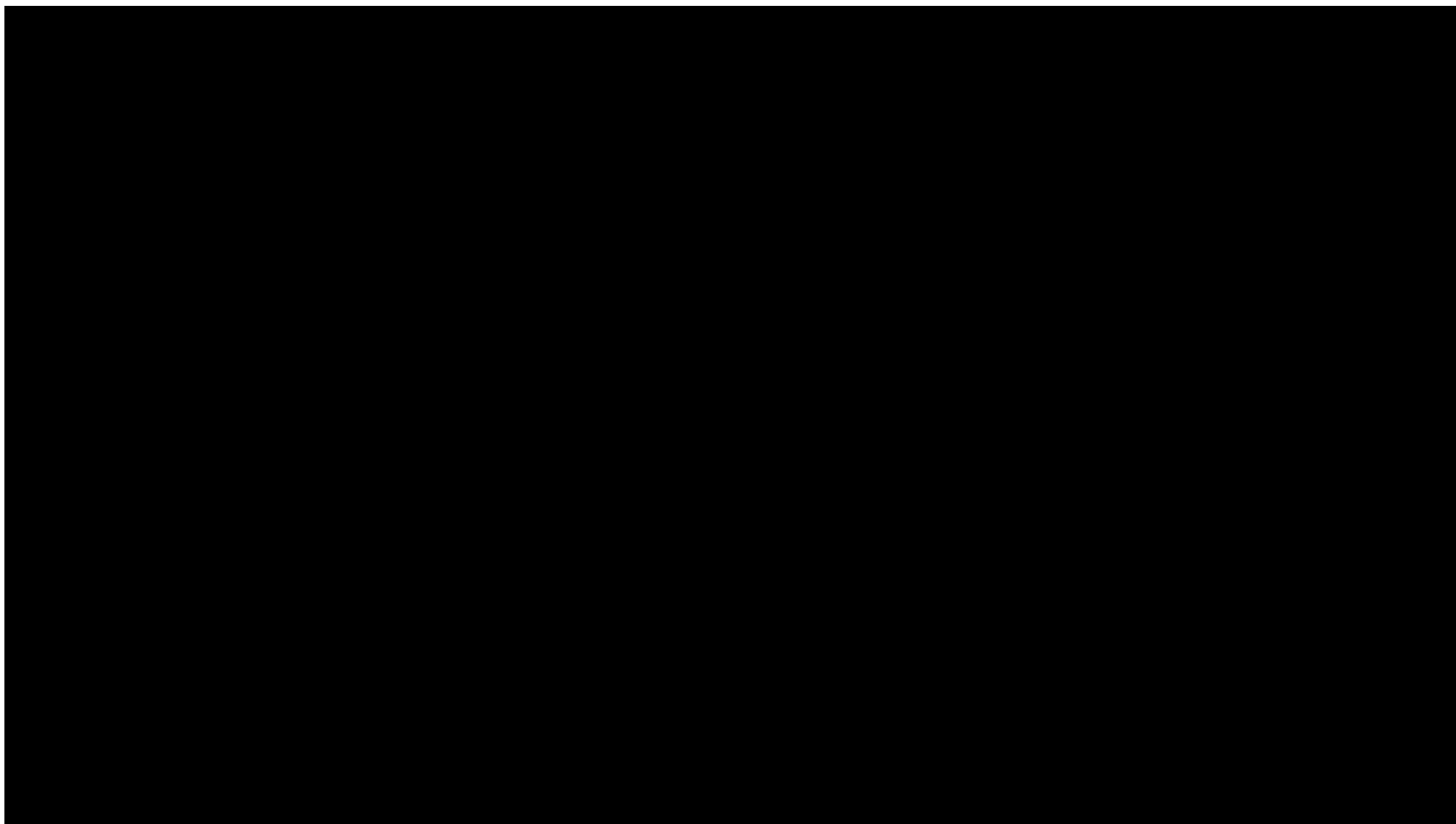
The OMAP-based board was implemented and tested using Linux and Android OS.



WP3 Development of the eGLASSES core platform (hardware and software) – 31.12.2016

The experimental chassis for eGlasses was designed and printed using 3D technology. The design was prepared for EARLY TESTS ONLY.



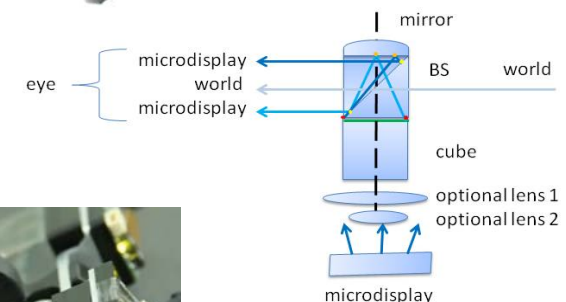
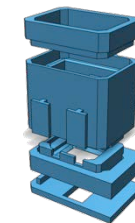


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WP4 Development of input/output extensions for the eGLASSES: an eye gaze-tracking module, a micro display and a proximity radar – 31.04.2016

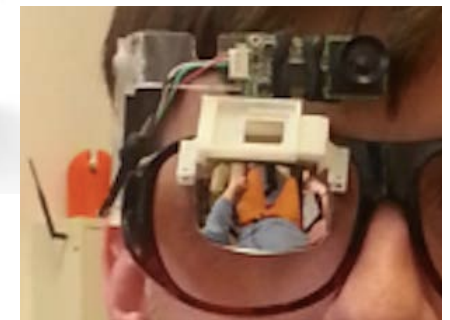
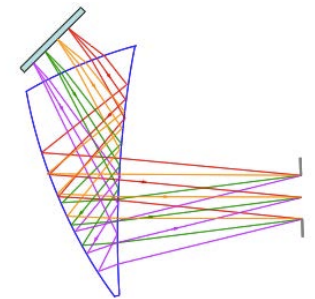
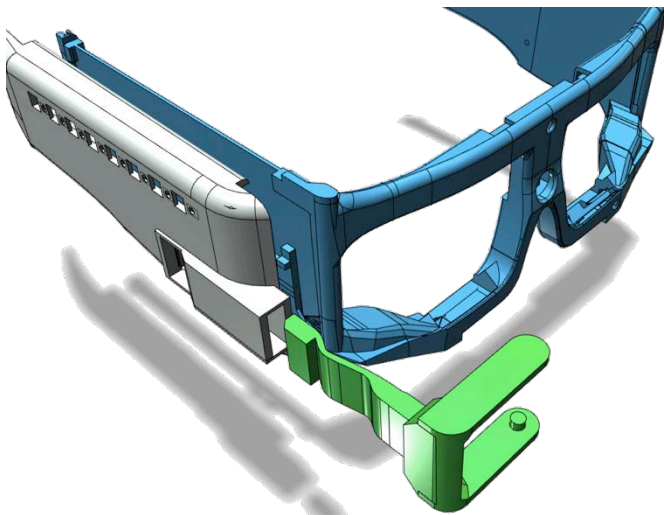
Different types of displays:

- opaque:
 - a) OLED microdisplay and Olightek optics
 - b) OLED microdisplay and Zeiss prism
 - c) OLED microdisplay and eMagin WFO5 prism
- semi-transparent:
 - a) OLED microdisplay and vertical beam splitter (Google Glass like)
 - b) OLED microdisplay and horizontal beam splitter (eIVision)



WP4 Development of input/output extensions for the eGLASSES: an eye gaze-tracking module, a micro display and a proximity radar – 31.04.2016

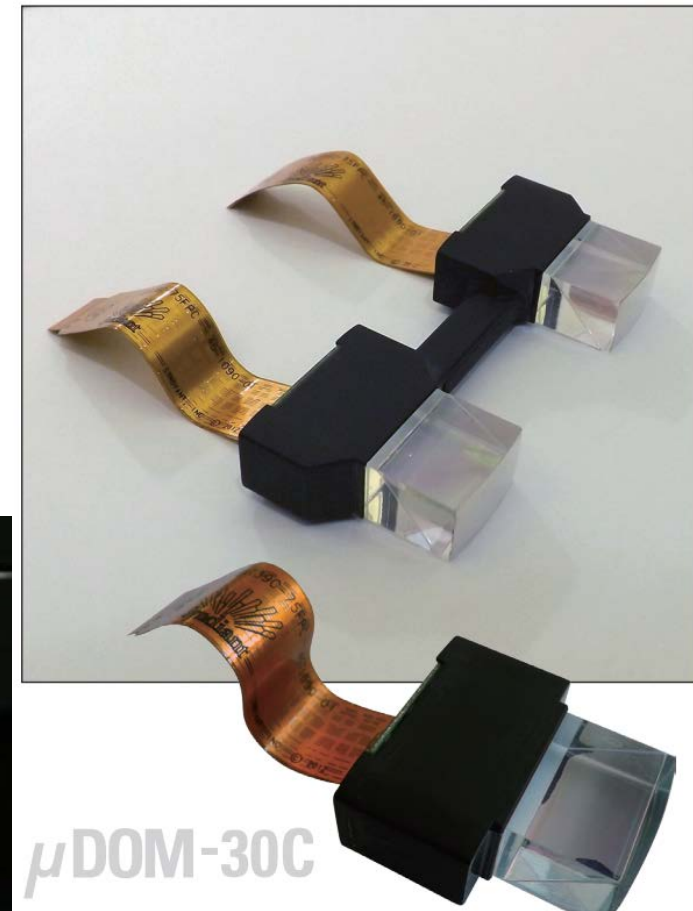
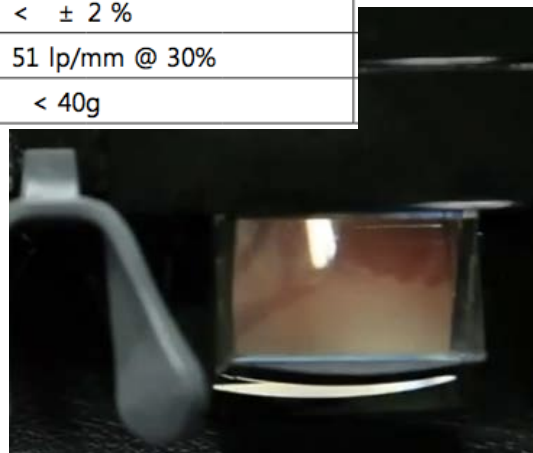
For first tests, the universal display connector has been design to work with three types of the near-to-eye displays using opaque optics.



WP4 Development of input/output extensions for the eGLASSES: an eye gaze-tracking module, a micro display and a proximity radar – 31.04.2016

Elvion semi-transparent optics

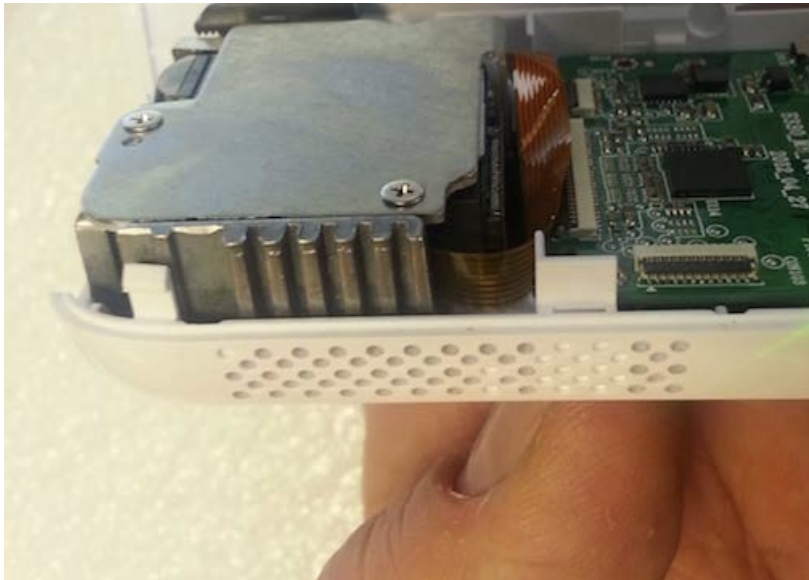
Item	Description	
Lens	Beam Splitter	Plastic
	Lens	Plastic
EFL	28.34 mm	
FOV (Field Of View)	40° (Semi-angle : 20°)	
Eye Relief Distance	17 mm	
Exit Pupil Diameter	> 3 mm	
OAL (Overall Length)	64.1 mm	
Virtual Image Size	86 inch @ 3 m (2184 mm @ 3000mm)	
Distortion	< ± 2 %	
MTF	> 51 lp/mm @ 30%	
Weight	< 40g	



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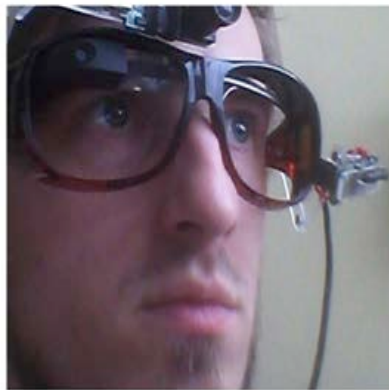
WP4 Development of input/output extensions for the eGLASSES: an eye gaze-tracking module, a micro display and a proximity radar – 31.04.2016

In the following weeks...

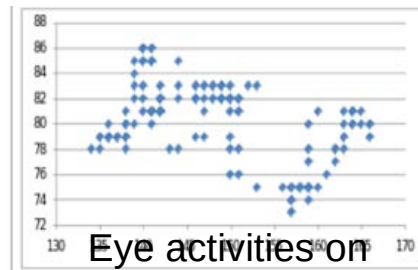


WP4 Development of input/output extensions for the eGLASSES: an eye gaze-tracking module, a micro display and a proximity radar – 31.04.2016

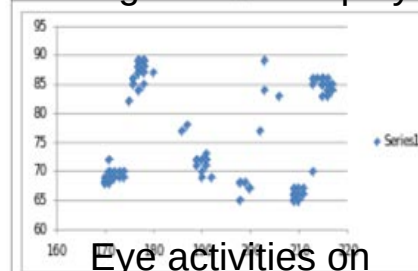
New eye-tracker (standalone, before integration with the eGlasses chassis) was designed and implemented. It was successfully tested. In the following weeks it will be integrated with the eGlasses electronics.



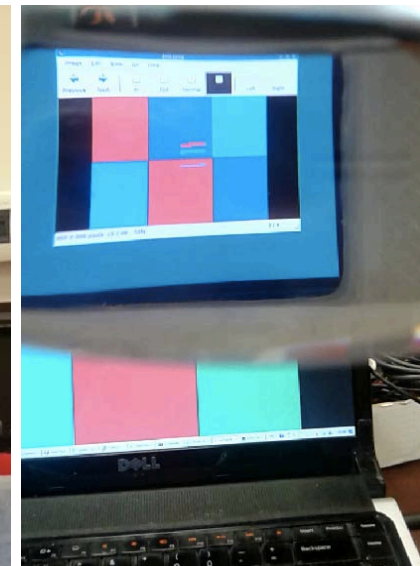
(a)



Eye activities on Google Glass display

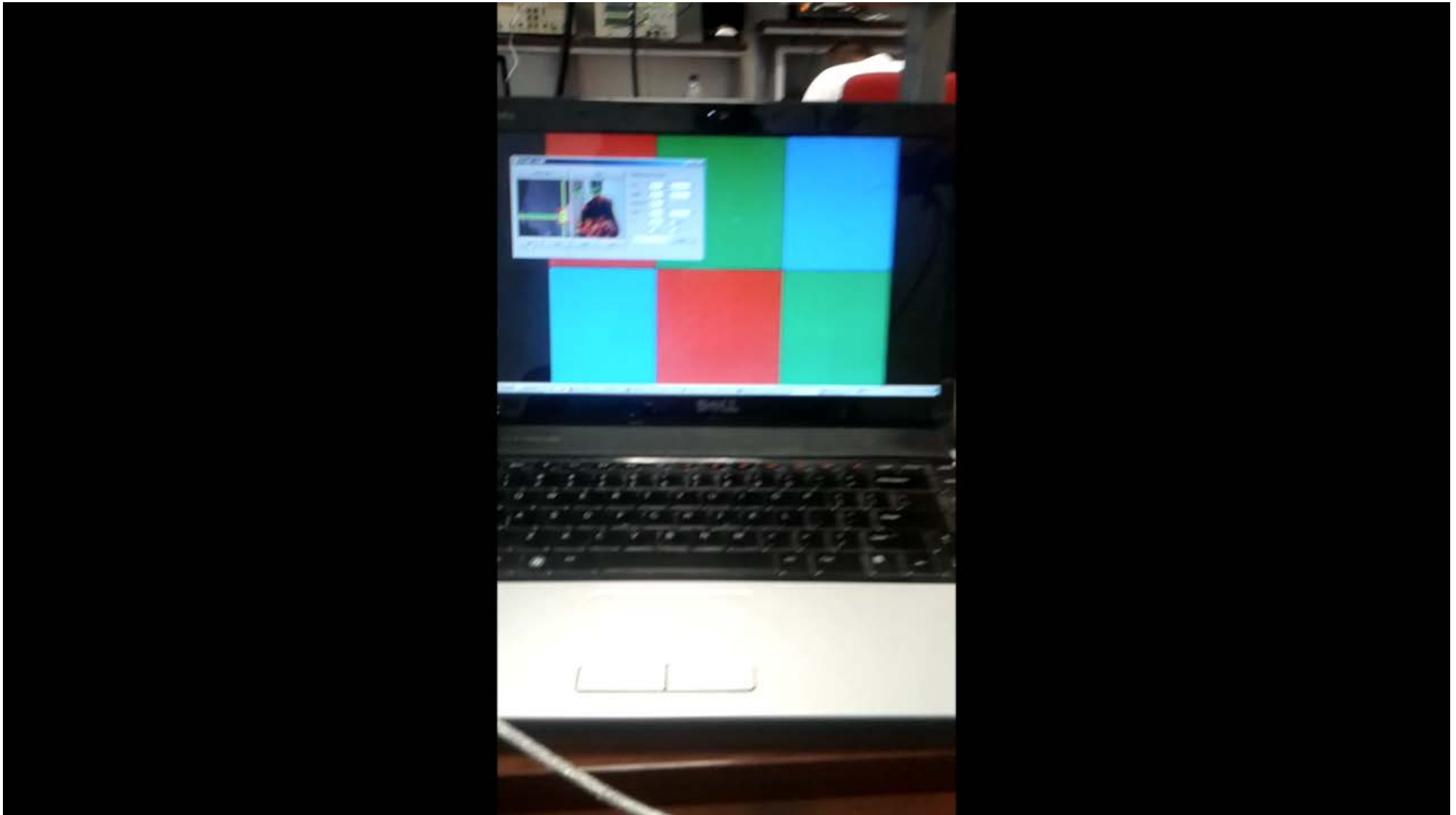


Eye activities on 14" monitor



Google Glass and the prototype of the eye-tracking module

Opaque micro-display and the prototype of the eye-tracking module



Opaque micro-display and the prototype of the eye-tracking module

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WP4 Development of input/output extensions for the eGLASSES: an eye gaze-tracking module, a micro display and a proximity radar – 31.04.2016

To estimate the range of the parallax error a set of measurements were performed. Test boards were used at different distances. Restricted head movements were assumed. The head of each volunteer was fixed in the frame of reference.

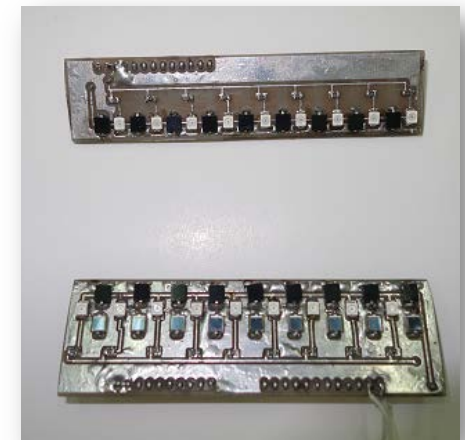
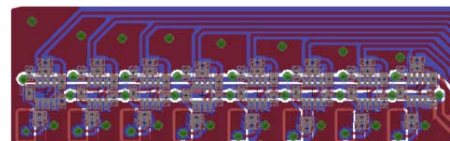
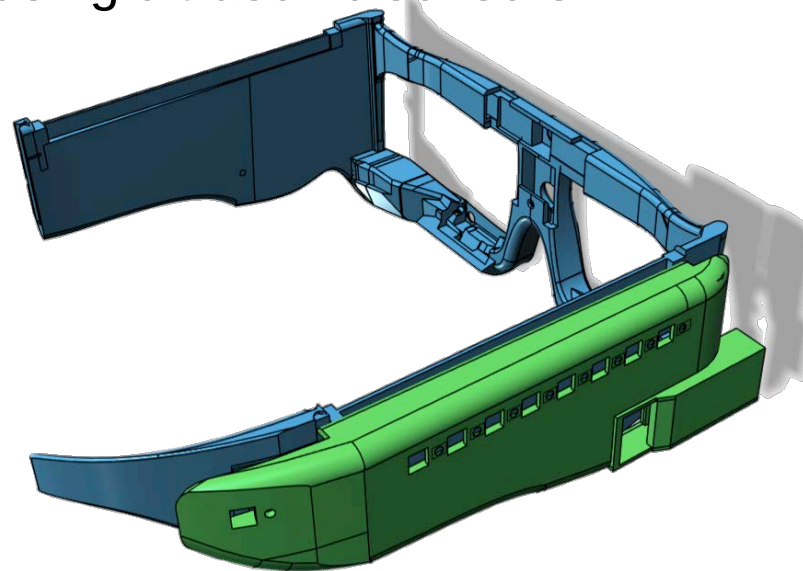
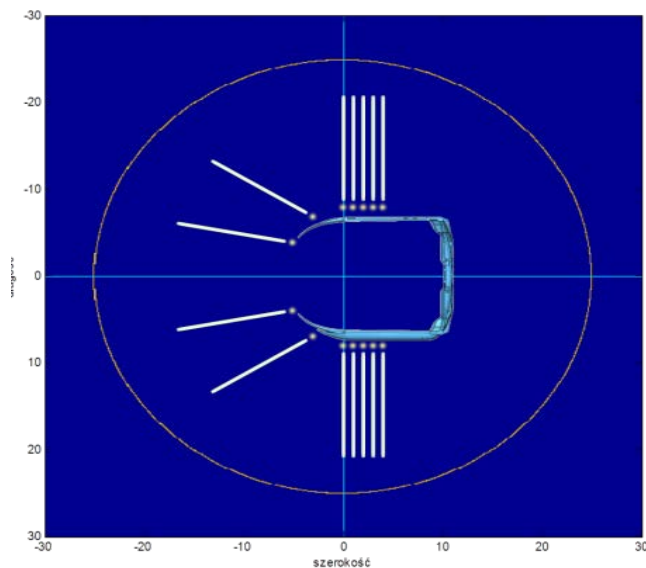


The average error computed for the test boards placed at different distances to the user was 1.11cm at 60cm, 1.75cm at 120cm, and 4.19cm at 180cm. For a 60cm distance the board size was 21x30cm, for a 120cm the board size was 30x42 and for a 180cm distance the board size was 42x60cm.

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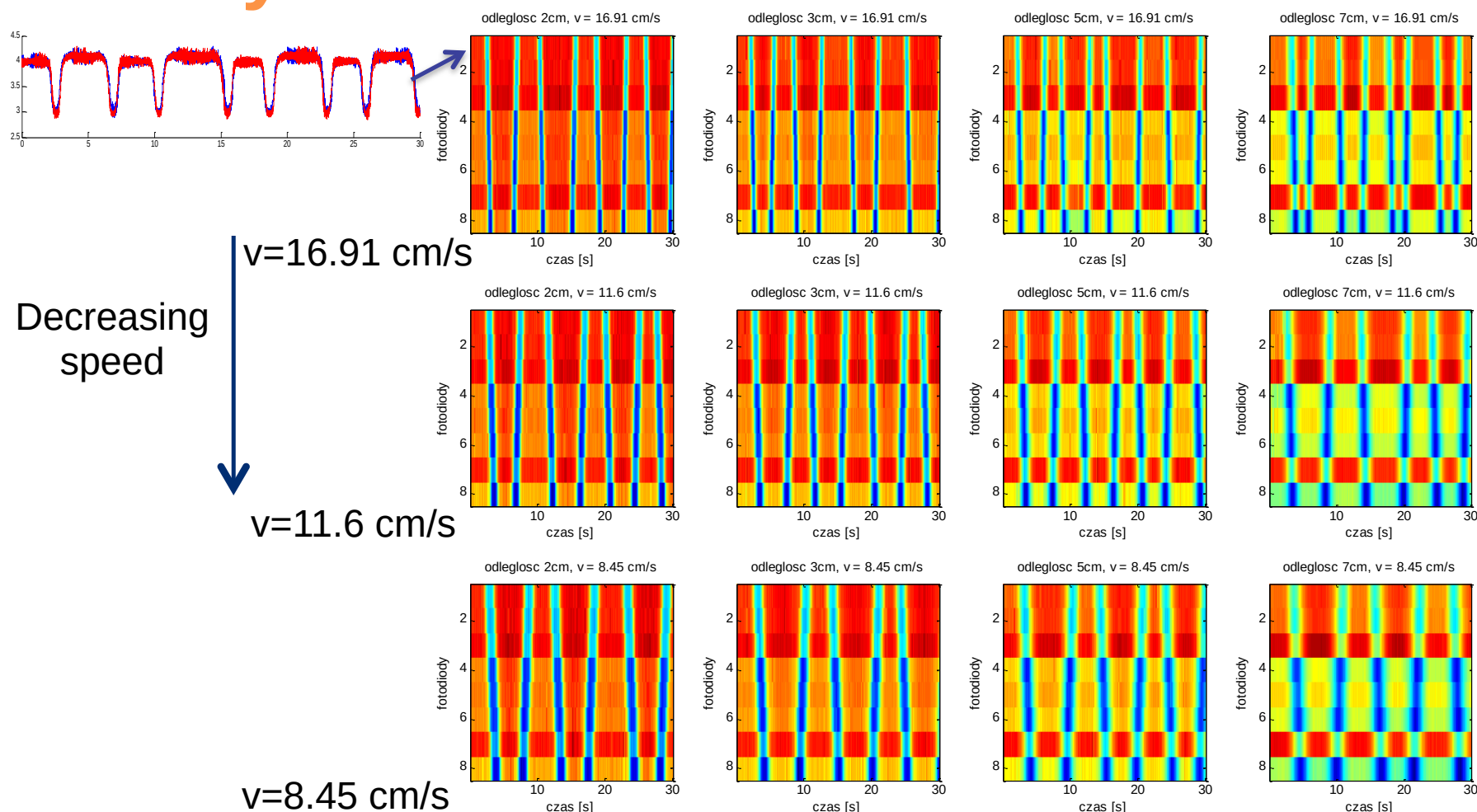
Different proximity radars have been designed and tested with photodiodes (passive and active) and using ultrasonic sensors.



Features

Velocity in x axis estimation

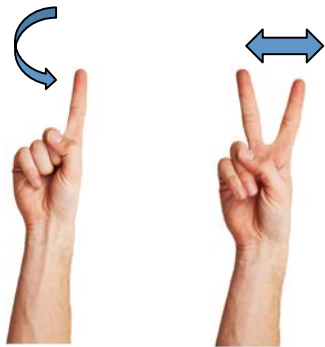
Increasing
distance to sensor



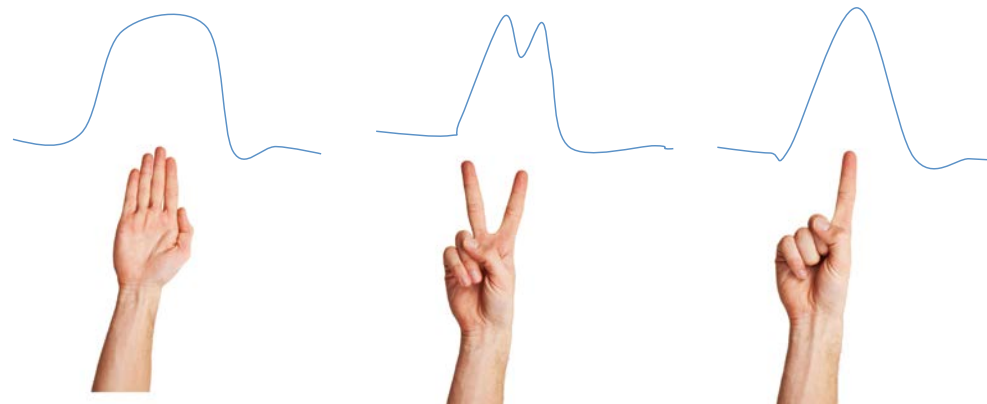
WP4 Development of input/output extensions for the eGLASSES: an eye gaze-tracking module, a micro display and a proximity radar – 31.04.2016

Experiments were performed to analyse errors in object speed estimation and object size estimation. The average error for 7 different distances (1-7 cm) and for 3 different speeds (8-17cm/s) was 6.51% (in the range of 2.14%-16.57%). For object size estimation the average error was 8.68% (in the range of 2.95%-15.62%).

This allows to investigate recognition of possible gestures and septic safe interactions:



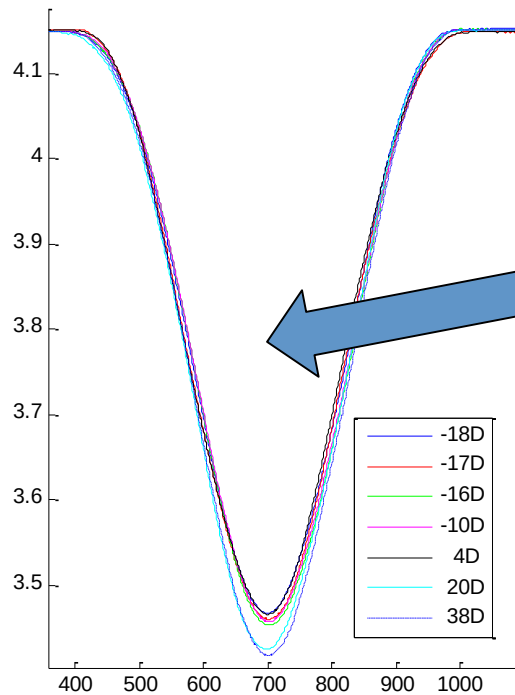
Dynamic gestures



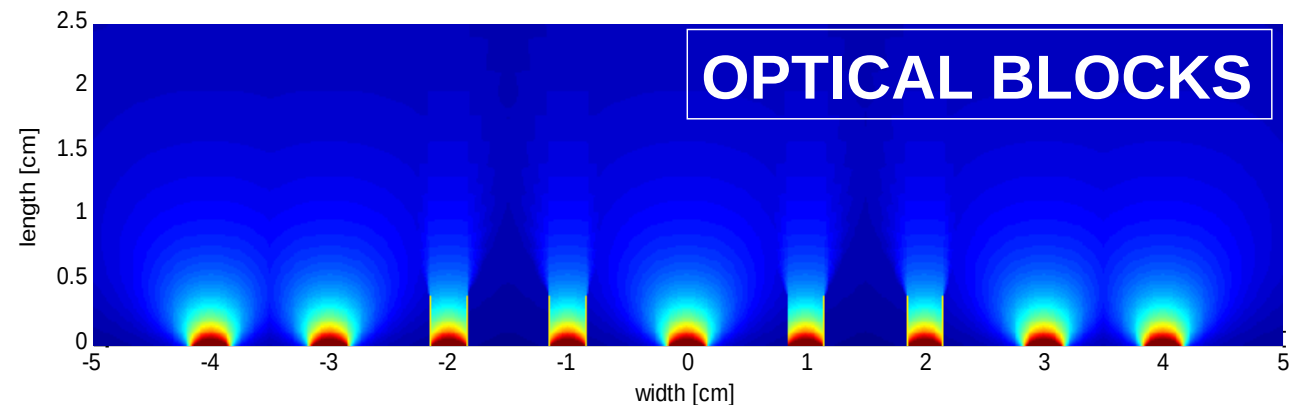
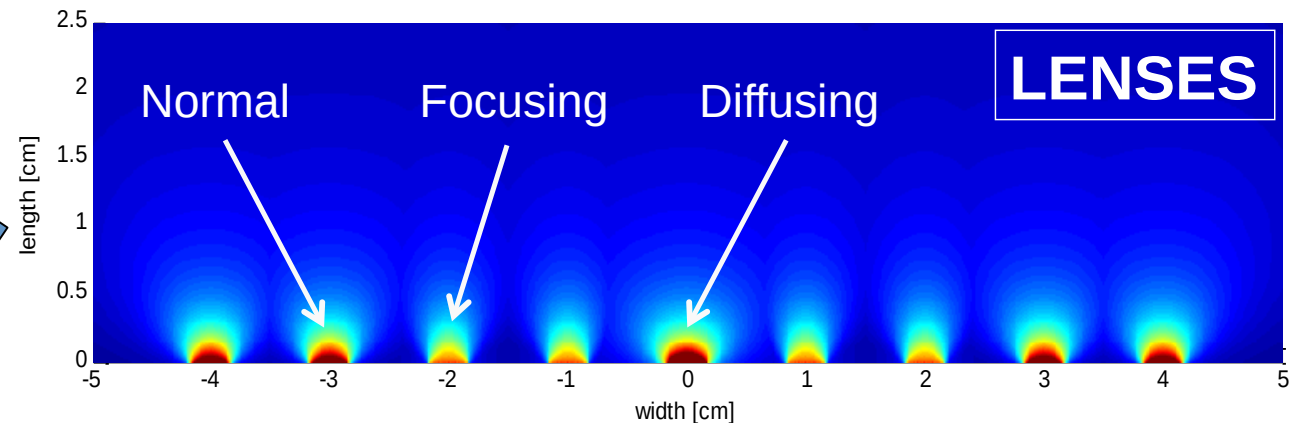
Static gestures

In order to distinguish whether head turns around or the object is circulating around, an accelerometer/magnetometer/gyroscope could be used.

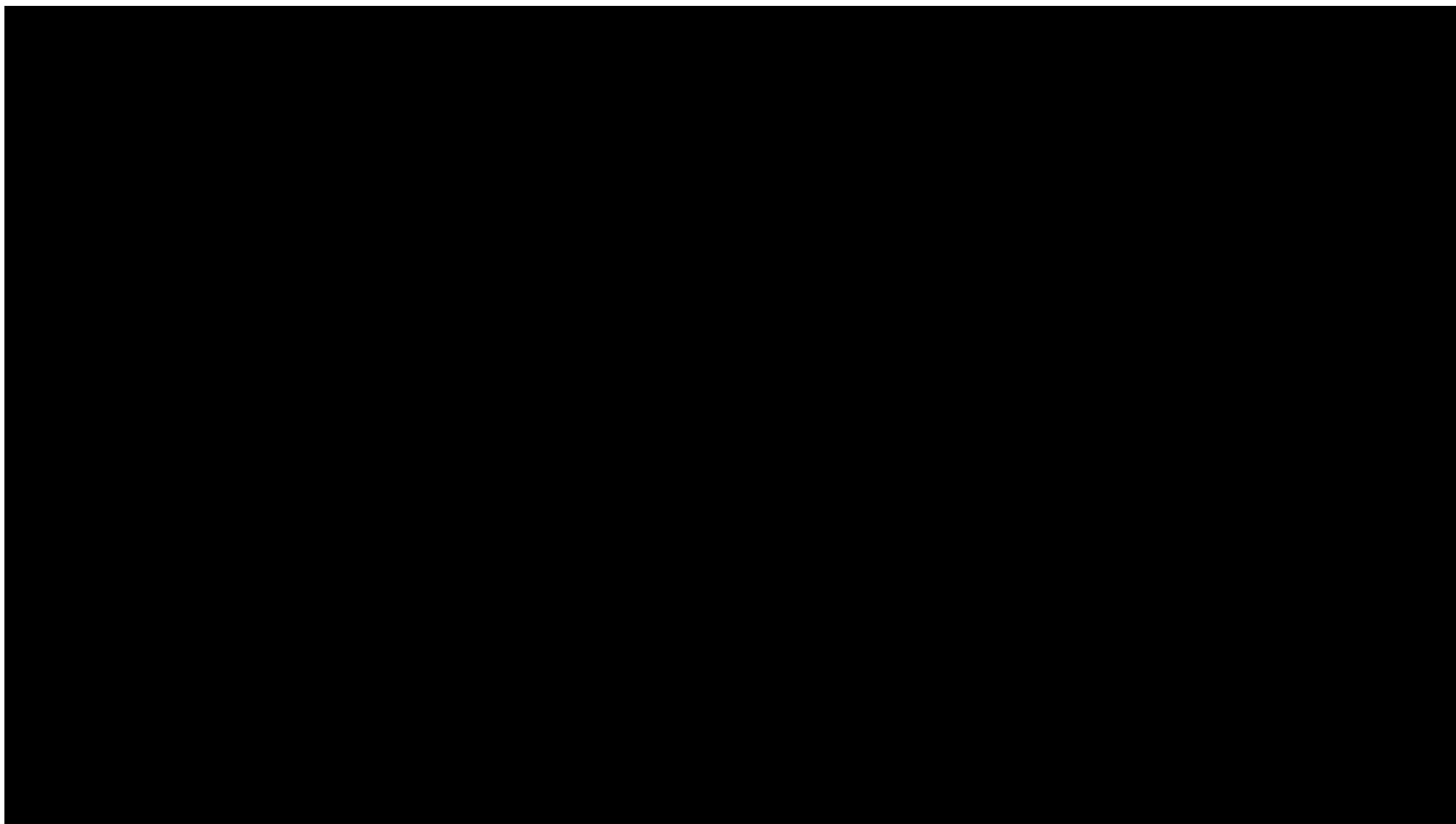
Gestures recognition - Selectivity improvement



Liquid lens application



The eGlasses consortium receives the funding support of NCBiR, FWF, SNSF, ANR, and FNR in the framework of the ERA-NET CHIST-ERA II.



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WP5 - Gestures and recognition of gestures:

Understanding the Everyday use of head-worn computers

Review in-depth head-worn computers in order to get a deeper understanding of...

- A** • **what** they are used **for** (ACTIONS),
- E** • **when** and **where** they are used (ENVIRONMENTS),
- I** • **how** they are used (INTERACTIONS)



- O** • **what** are the problems and limitations of the device (OBJECTS) and
- U** • **from whom** they are used (USERS).

These answers help us to **design** or **improve** head-worn displays in the **future**.

D5.1: a report (25 pages)

“AEIOU Framework (EthnoHub - documentation of online tools for qualitative research),”

<http://help.ethnohub.com/guide/aeiou-framework>.

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WP5 - Gestures and recognition of gestures:

Understanding Smart fabrics and gesture-based interactions

Exploring different materials (fibers, yarns and fabrics) from

- a **textile** perspective (textile processing method, structure, etc.) and
- a **technical** perspective (conductivity, etc.)

in order to know the properties, which can be used for sensing techniques.

Experimenting with materials and textile processing methods



Material

Fibers 

Yarns 

Fabrics 

Ink 

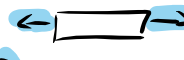
Tape 

Sensing Technique

Touch 

Pressure 

Bend 

Stretch 

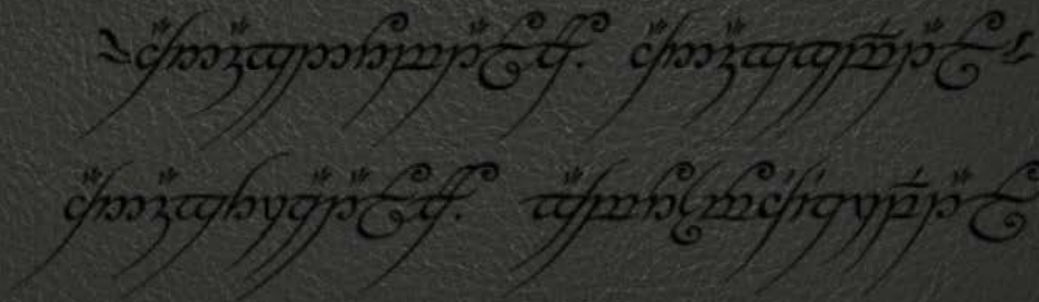
Tilt 

Proximity 

D5.2: a report (18 pages)

in order to create sensors, which can be used for the interaction with HWCs.

J. R. R. Tolkien *The Lord of the Rings*



WP6 Development, implementation and evaluation of reference applications – the healthcare professional assistant

Initial activities:

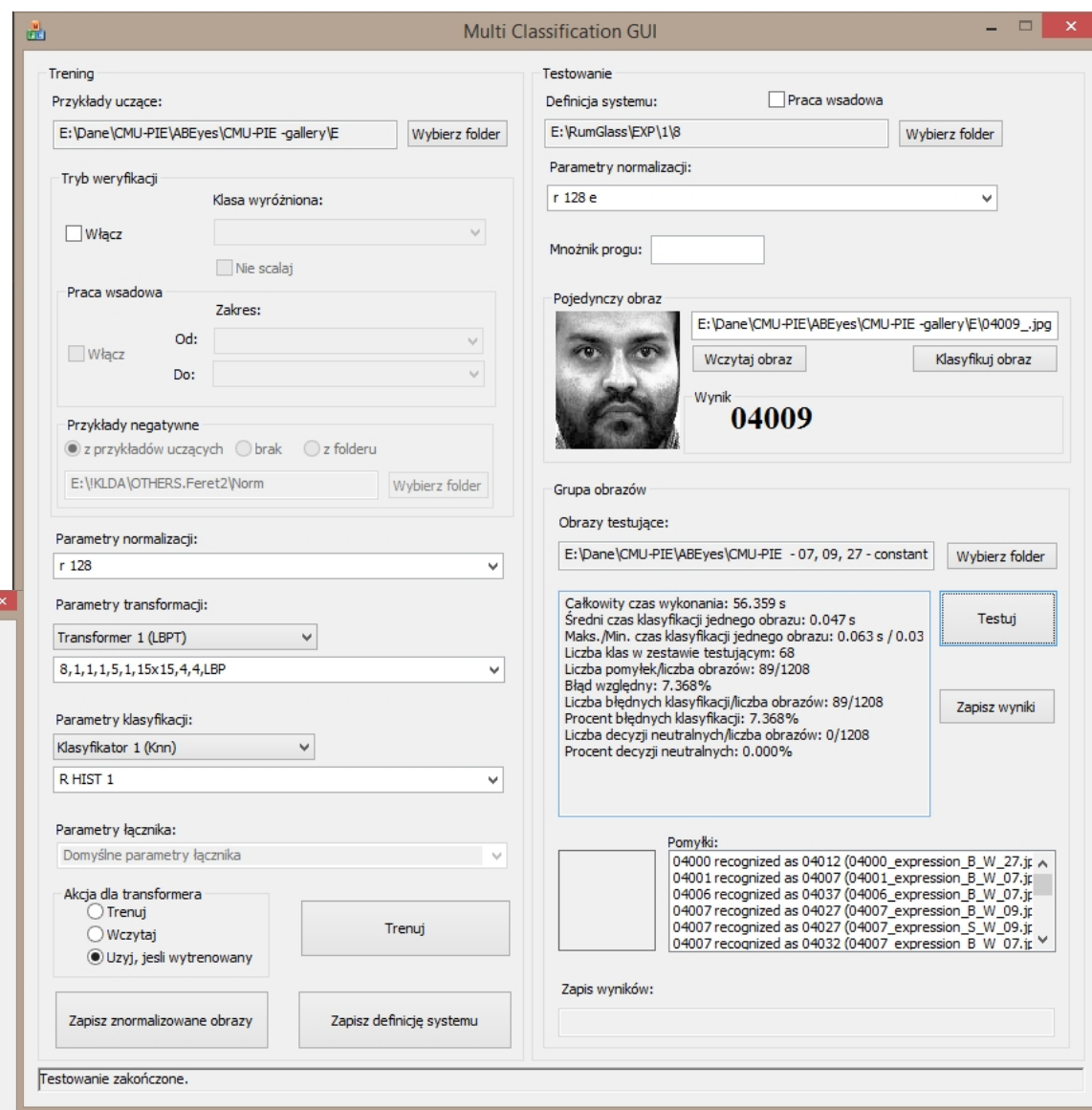
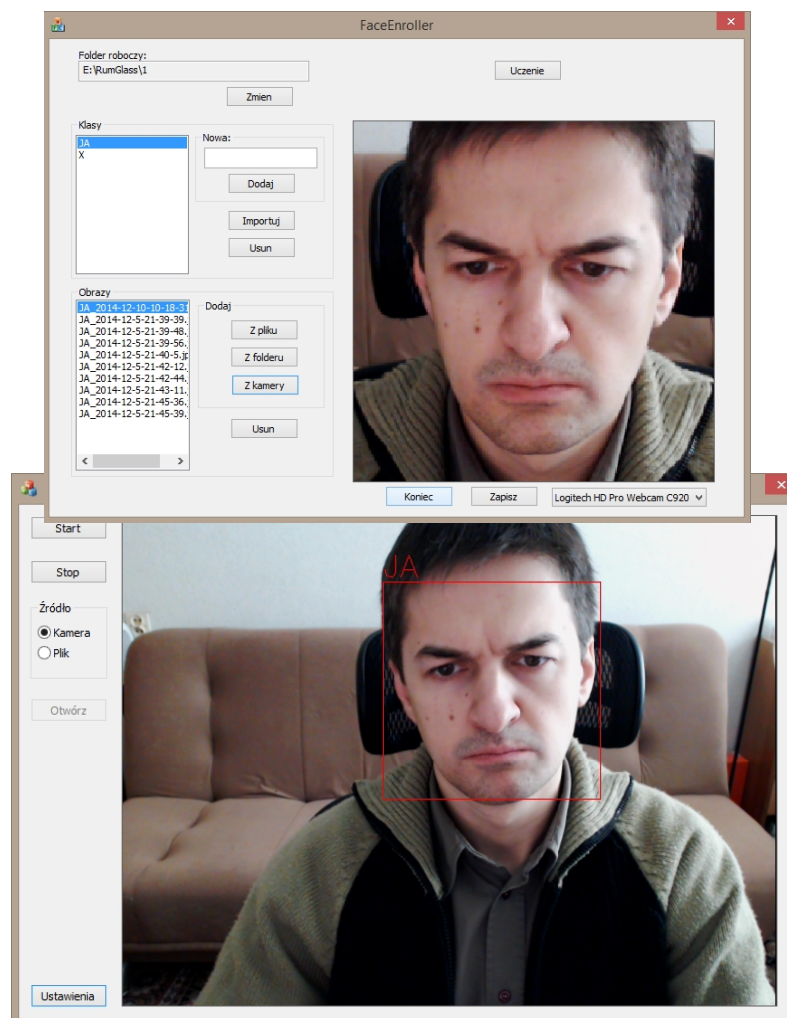
- a) **D6.1:** Requirements capture report (44pages)
- b) Identification of people/patients using face recognition or markers
- c) Face-based diagnostics

WP 6 – Person identification using face recognition

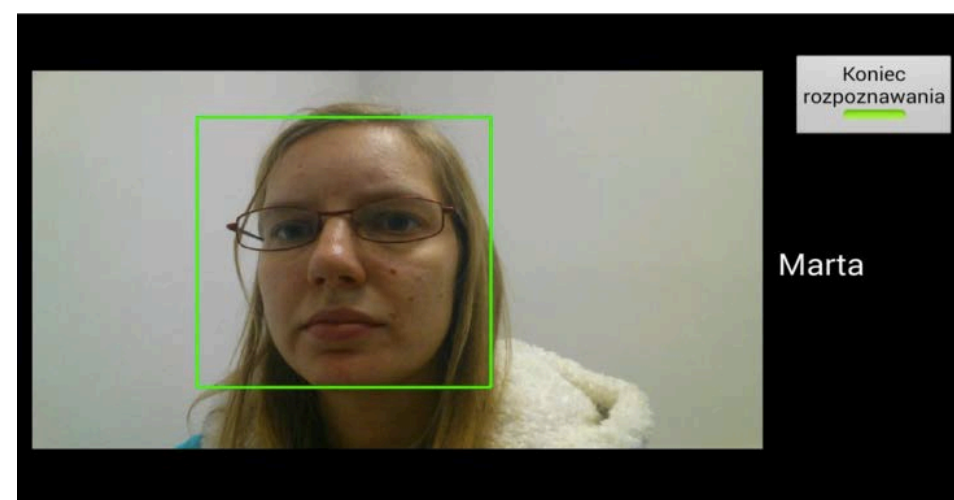
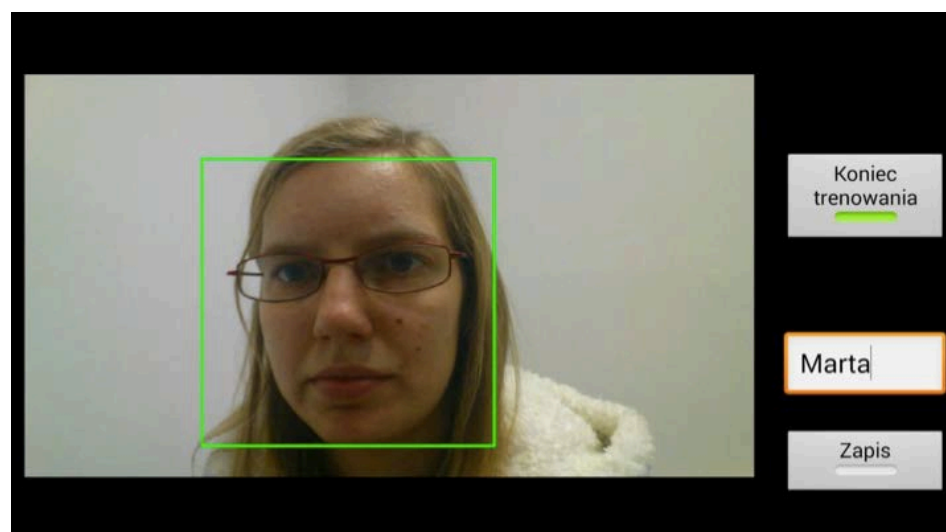
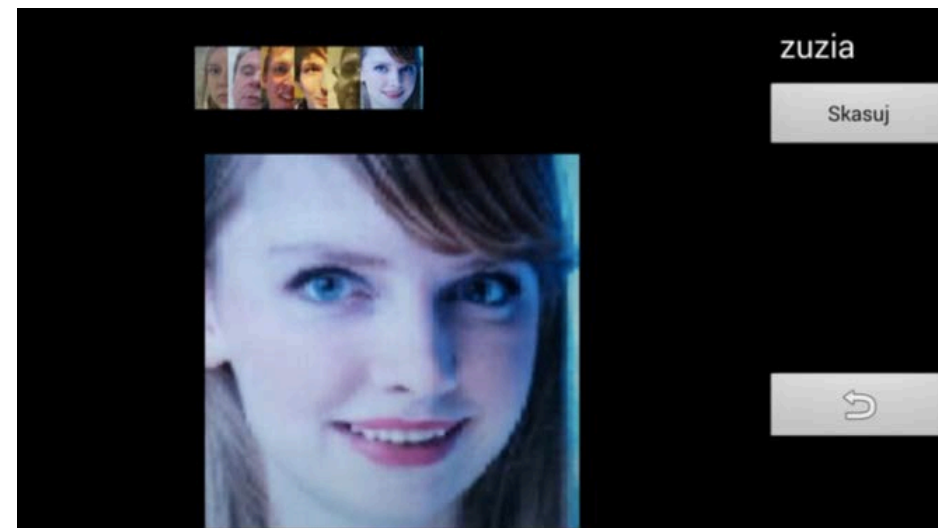
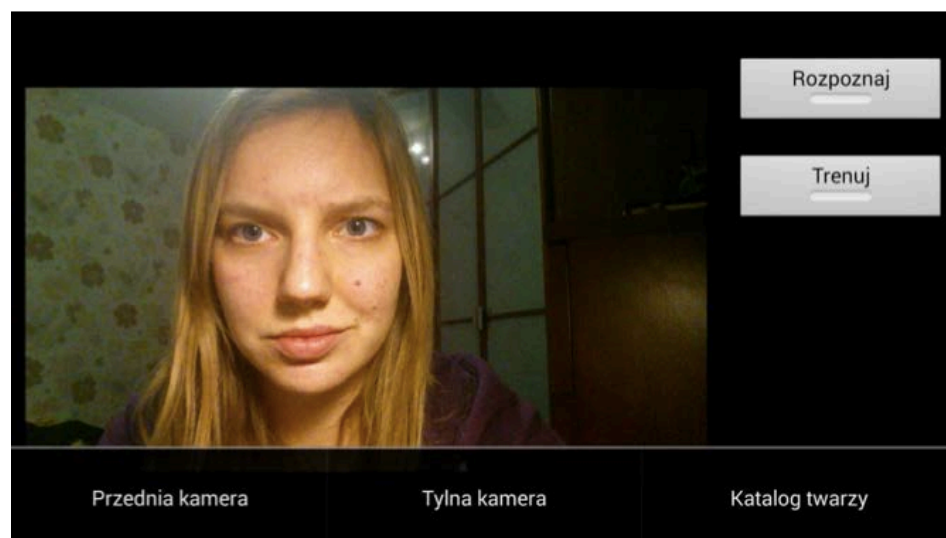
We are investigating different face recognition methods for the eGlasses platform (limited resources!). During the work on the face identification software for e-Glasses, three applications (C++) have been developed so far:

- 1) the face recognition engine generator equipped with the interface that facilitates batch testing of different configurations of the algorithm;
- 2) the recognition system generator that provides the interface for user enrollment (i.e. assigning identifiers to the images captured with a camera or included in graphic files) and for the training of the system based on the collected images, with the help of the recognition engine;
- 3) the face tracker that utilizes the system definition (created at the training stage) to detect and identify faces that appear in the video stream coming from a video file or directly from the camera.

Native implementation of algorithms

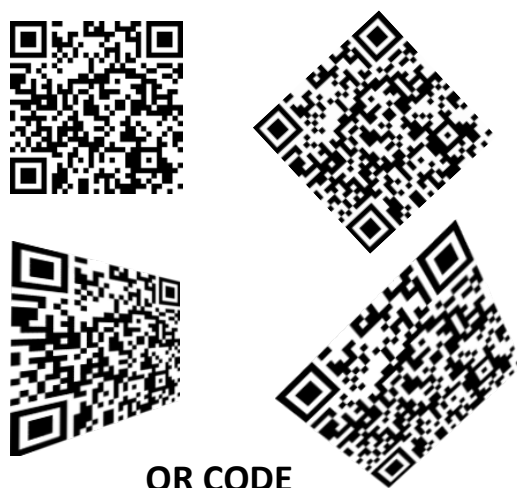


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WP6 Development, implementation and evaluation of reference applications – the healthcare professional assistant



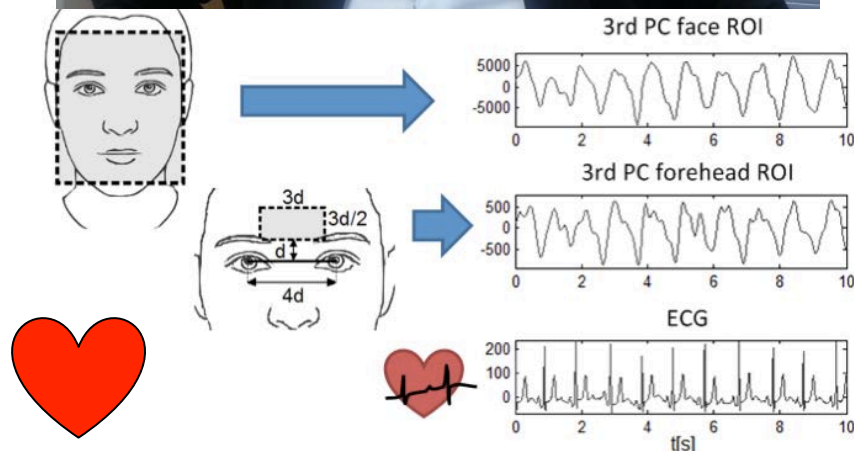
Aestheticodes

Recognizable for:	Smartphone LG	Smartphone Sony	Google Glass
Short distance (5-10 cm)	37,5 %	15,3 %	9,7 %
Medium distance (11-30 cm)	57 %	59,7 %	25 %
Long distance (31-50 cm)	8,3 %	66,6 %	0 %
Rotated code	57,7 %	37,7 %	20 %
Sloped code	35,5 %	46,6 %	13 %
Rotated and sloped code	26,6 %	37,7 %	0 %
Big code (3,8 cm)	68,3 %	50 %	41,6 %
Small or medium code (0,4/1,7 cm)	32,5 %	40 %	0 %
Good quality	53,3 %	48,3 %	15 %
Bad quality	38,3 %	40 %	13 %

WP6 Development, implementation and evaluation of reference applications – the healthcare professional assistant



WP6 Development, implementation and evaluation of reference applications – the healthcare professional assistant



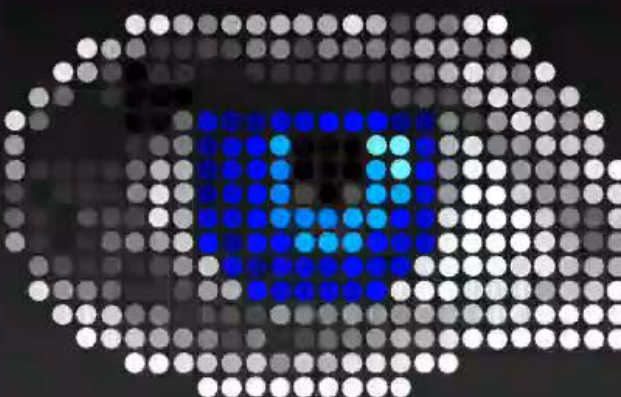
The eGlasses consortium receives the funding support of NCBiR, FWF, SNSF, ANR, and FNR in the framework of the ERA-NET CHIST-ERA II.

WP7 Development, implementation and evaluation of reference applications – the assistant tool for the disabled and the tool for context-aware behavioural studies

Initial activities:

- a) [D7.1](#): Requirements capture report (76 pages)
- b) [D7.3](#): Identification of colors (software and the report)
- c) Interactions with recognized (controllable) objects
- d) Text entry using traditional sensors

**poznaj
kolory**



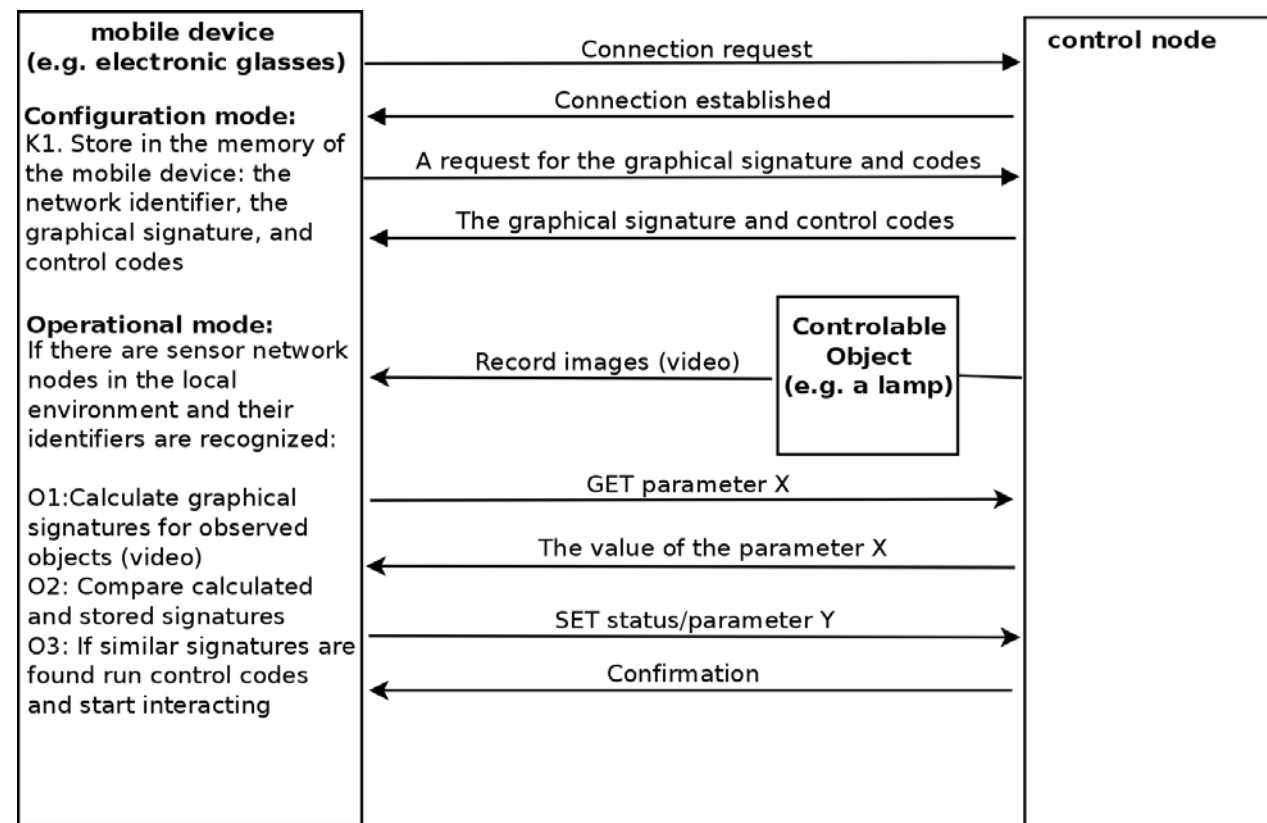
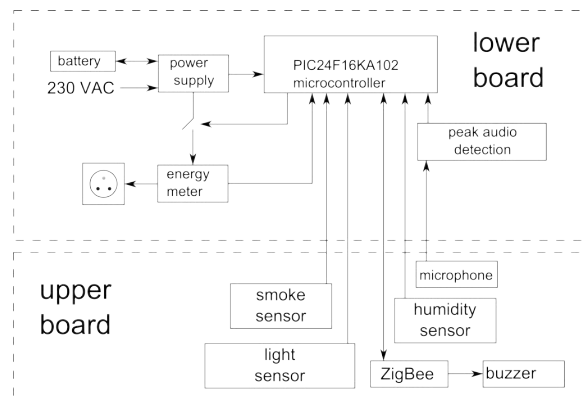
**learn
colors**

color recognition, color blindness simulation
rozpoznawanie kolorów, symulacja daltonizmu

Instrukcja (User Guide) -> MENU/Info

WP7 – Interactions with recognized (controllable) objects

The method of the interaction with the recognized objects assumes that any kind of controllable object (a lamp, a TV set, an air-conditioning system, a robot, etc.) is connected to a control node. The control node is equipped with a wireless interface, a microcontroller, memory and additional sensors or actuators.



WP7 – Interactions with recognized (controllable) objects

Configuration mode:

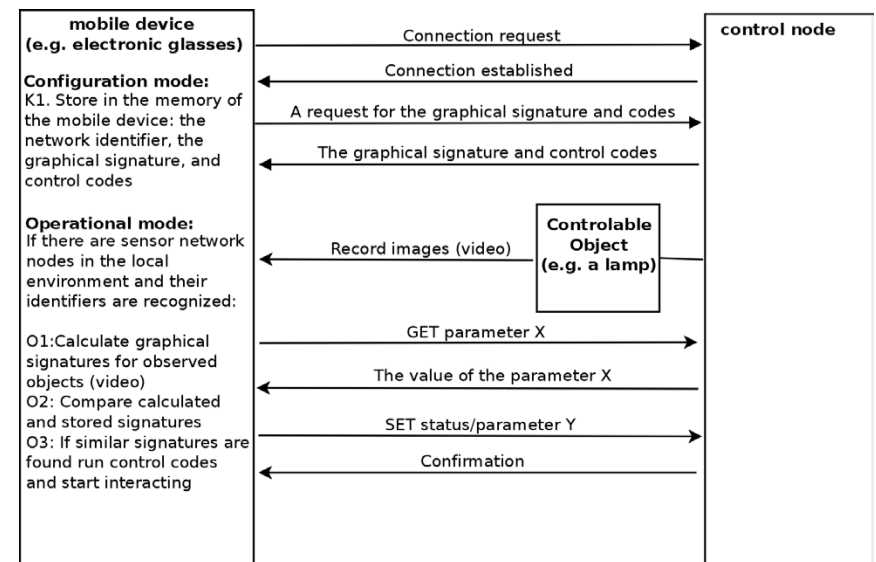
- discover/download graphical signature of the object and related code (drivers, GUI),
- associate the object ID with the downloaded data

Operational mode:

- perform object detection/recognition actions (graphical features and Network ID)
- if the object is recognized start the related code



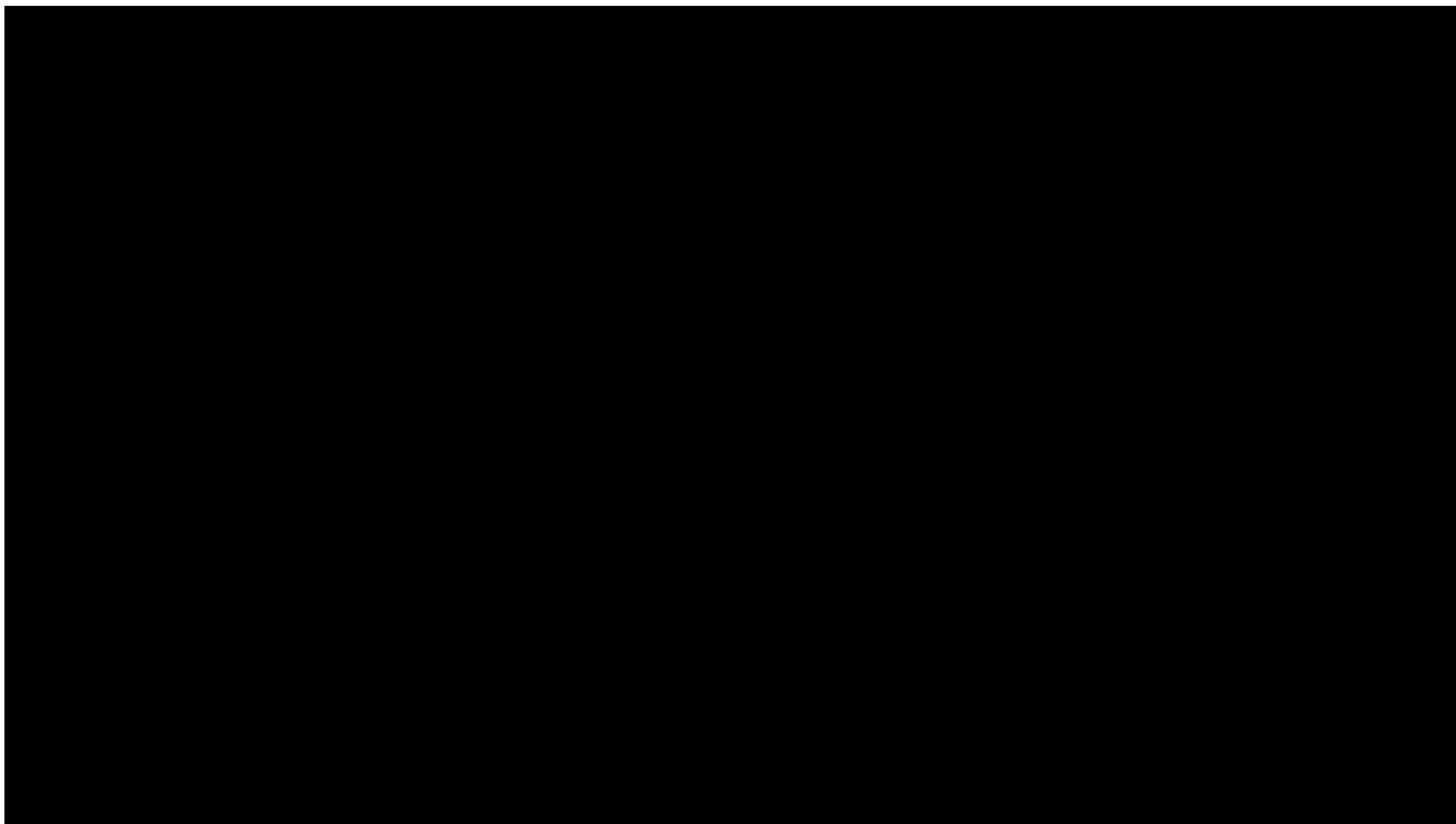
USB/Serial ZigBee node Android 4.2



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WP7



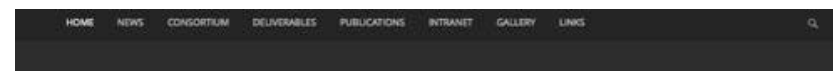


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WP8 Dissemination activities and promotion



gadgets



eGlasses

Era-Net-Chist-Era-II

www.eglasses.eu



brochures

Home

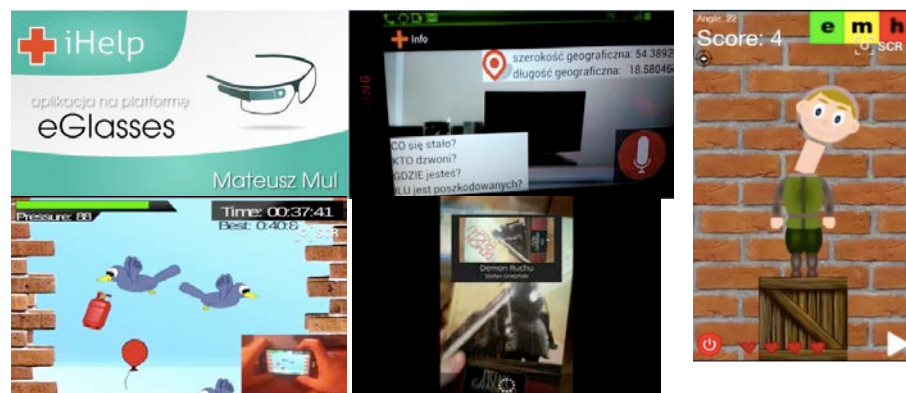
The eGlasses project is focused on the development of an open platform in the form of multisensory electronic glasses and on the inte-

Conferences:

- Human System Interaction (IEEE, Portugal, June 2014)
- Ambient Assisted Living Forum (Romania, 2014)
- NordiCHI-2014 (Finland, October 2014)
- SIGGRAPH (Canada, August, 2014)
- UIST 2014 (USA, 2014)

Trades:

- Technicon Innovations (Poland, October, 2014)



Students' projects

Presentation plan

- Project title, project start date
- Scientific background and objectives of the project
- Presentation of the consortium: introduction of each partner
- Presentation of the workplan
- Elements on project management
- Early results
- Valorisation

Prototypes

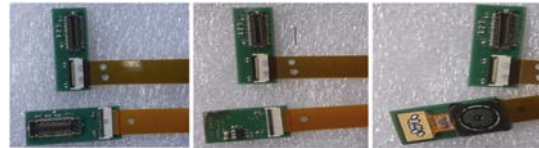
1. The main CPU board



2. Side board



3. Camera interfaces



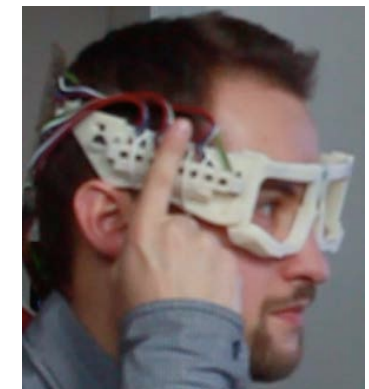
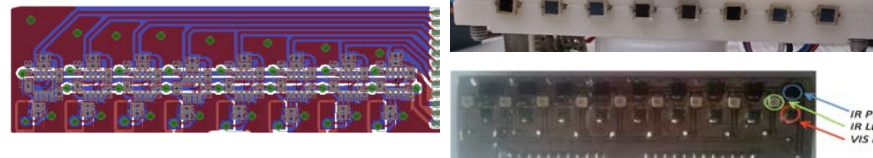
4. Camera multiplexer



5. Display interface

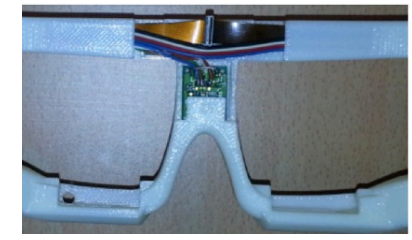


6. Proximity radars



Prototypes

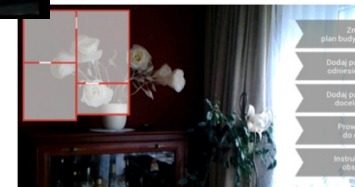
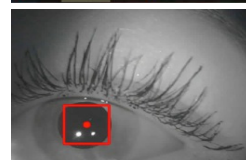
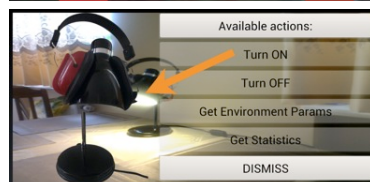
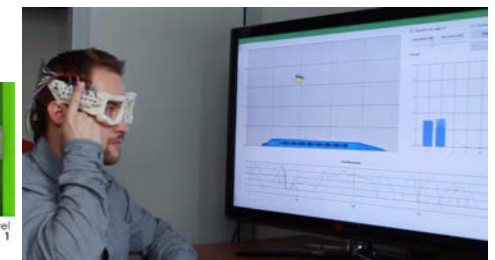
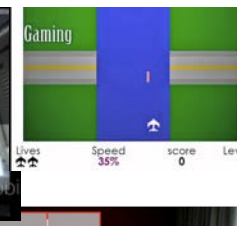
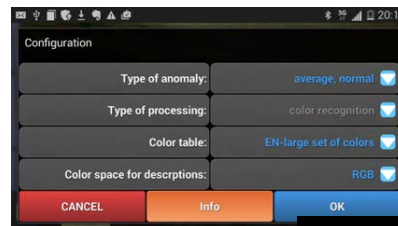
7. Hardware mechanics



8. Redesigned Eye - tracker



9. Numerous low-level and high level software packages



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Acknowledgment



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Projekt eGlasses współfinansowany ze środków Narodowego Centrum Badań i Rozwoju w ramach programu europejskiego ERA-NET CHIST-ERA II