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# OLED based binocular interactive see-through HMD

SID2012 Exhibitors' Forum

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5.06.2012

## Outline

- Introduction
- System Overview
- Applications



# Introduction

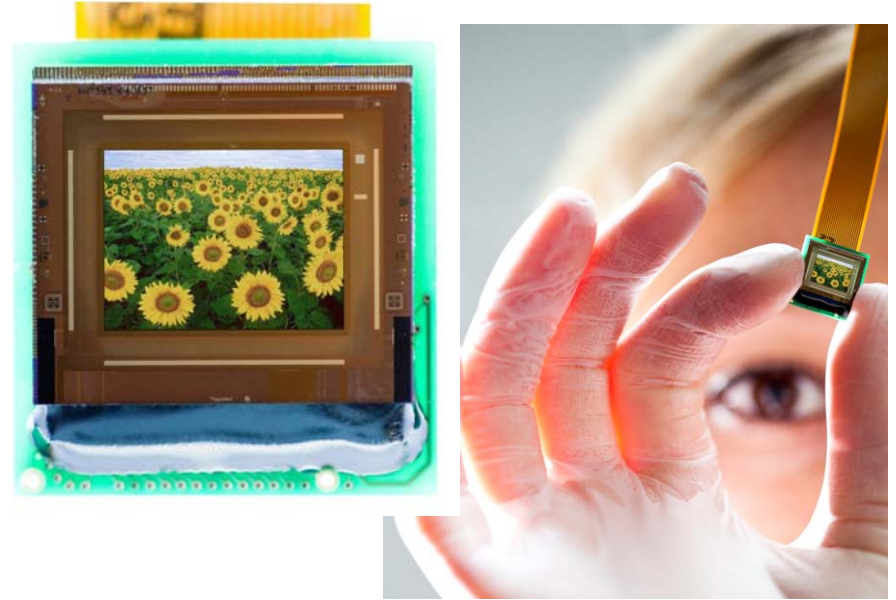
## OLED-Microdisplay

- Excellent contrast ratio
- Large dynamic range
- Low power consumption

State of the art: Uni-directional output

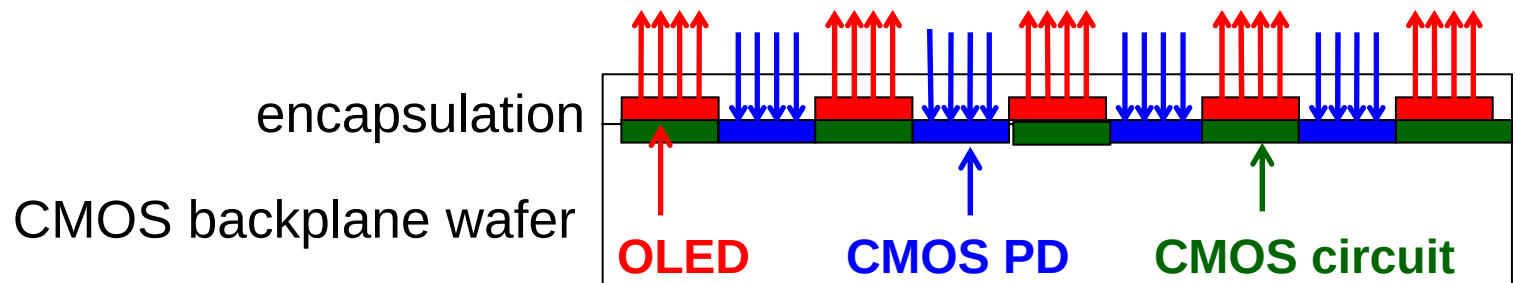
Additional *image sensor*

Beyond state of the art: Bi-directional input+output



Uni-directional display: VGA, 6x8mm<sup>2</sup>  
([www.hypoled.org](http://www.hypoled.org))

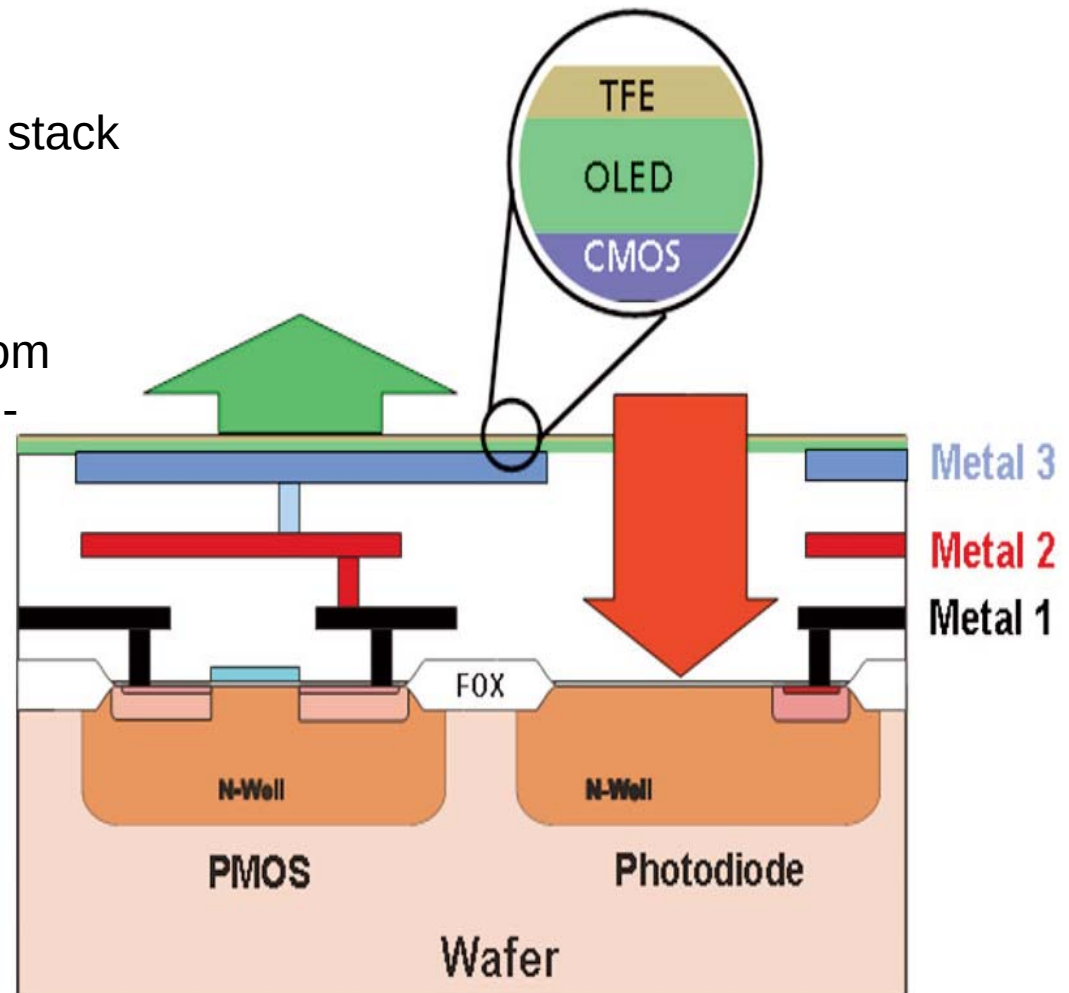
## Diversity of new applications



# Introduction

## Bidirectional OLED-Microdisplay

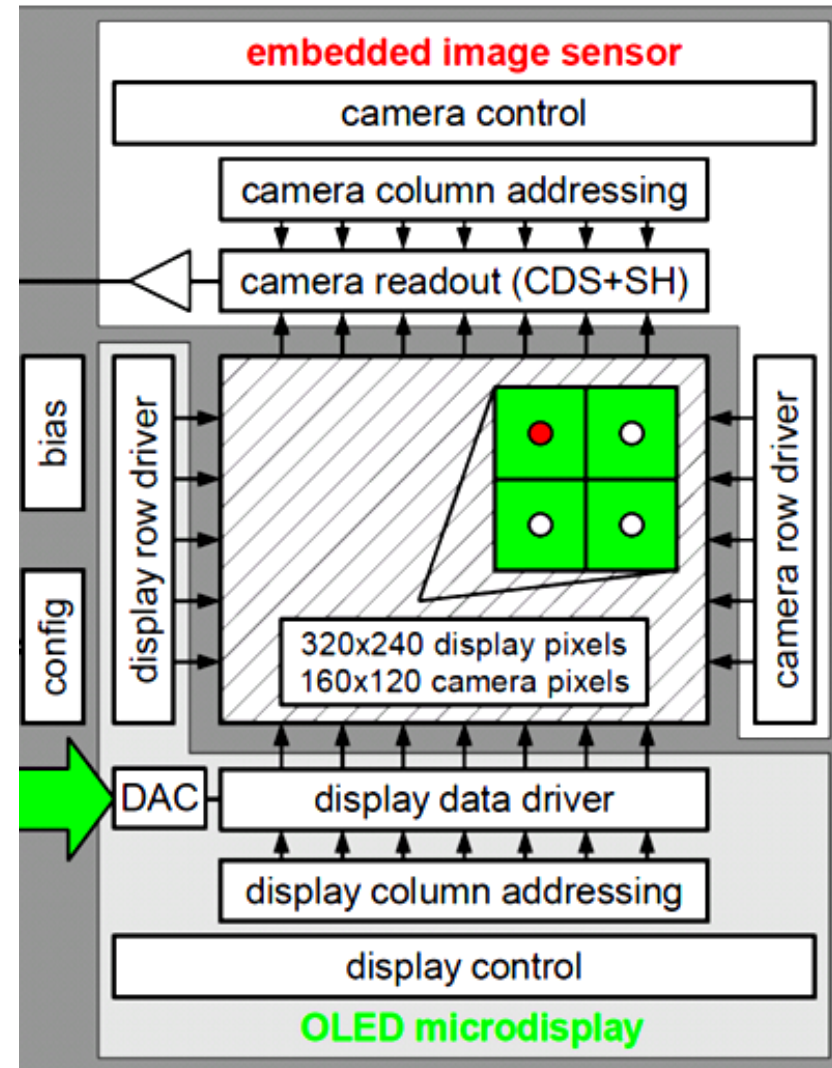
- Top-emitting OLED
- Direct evaporation of OLED stack through a shadow mask
- Unpatterned OLED
- Pixel shape defined by bottom electrode (CMOS top metal - anode)
- Common cathode
- Colour filter (optional)



# Introduction

## Chip-architecture

- Nested display and image sensor pixel matrix
- Separated controls
- Configuration via IIC
- Common bias block
- External ADC
- Mobile host system for data processing and applications



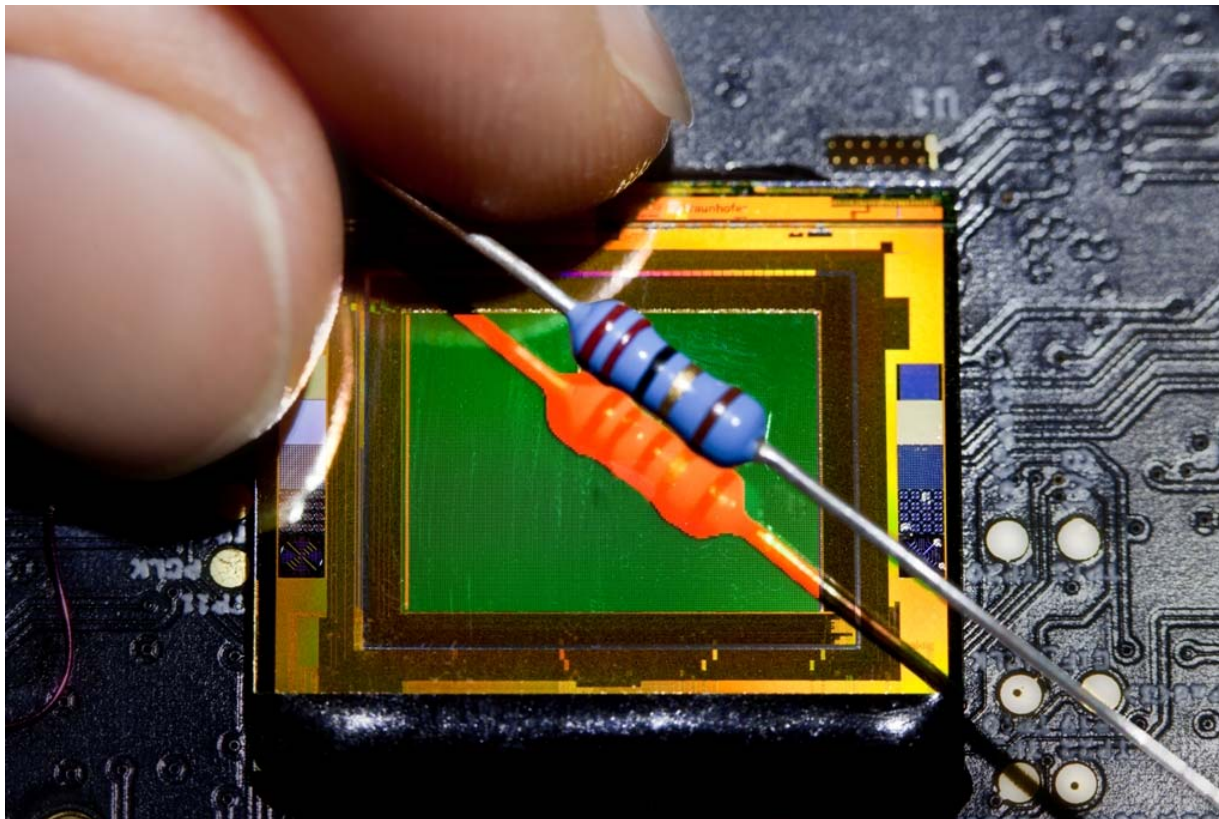


# Introduction

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## Bidirectional OLED-Microdisplay feedback mode demonstrator

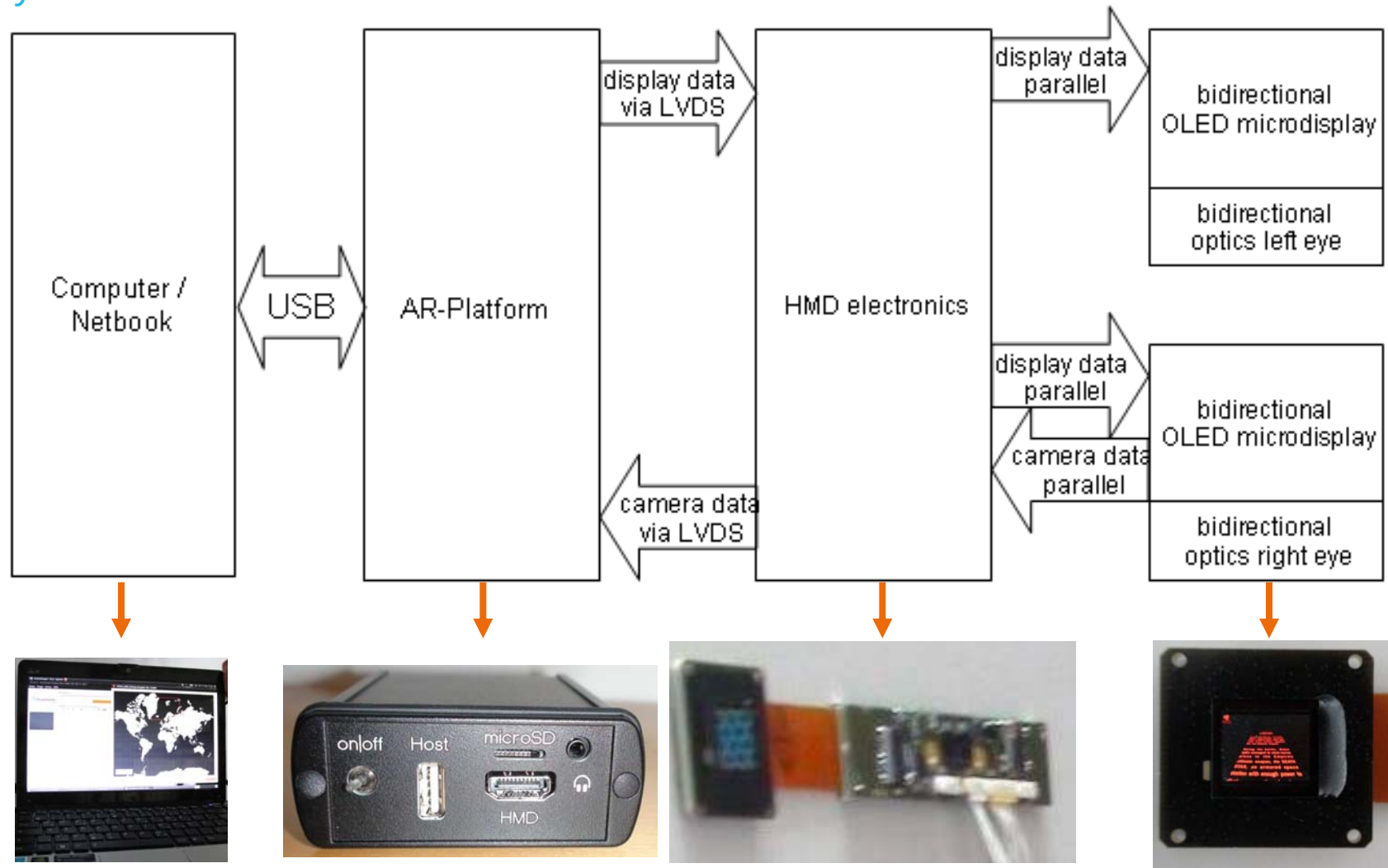
- Acquired image directly fed back into display



See this demo  
at booth #1371!

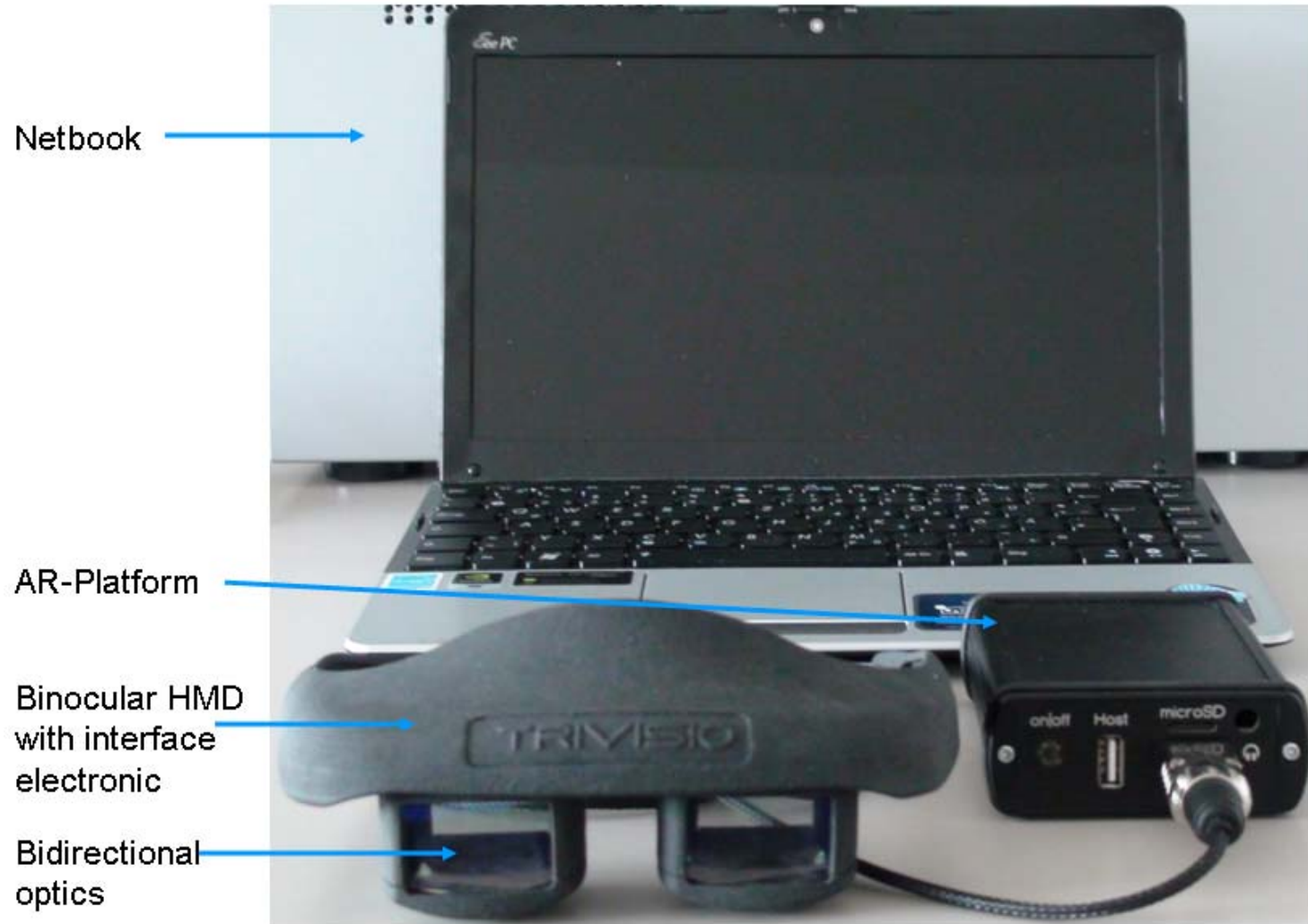
# System Overview

## System architecture



# System Overview

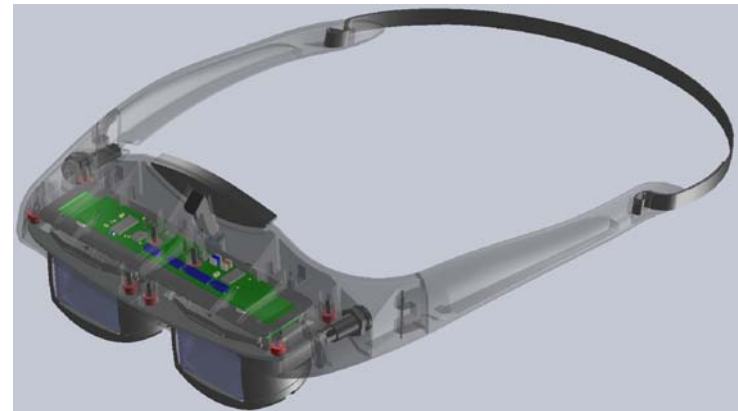
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# System Overview

## Specifications:

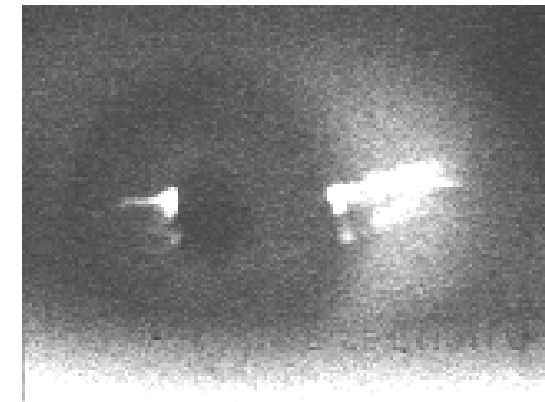
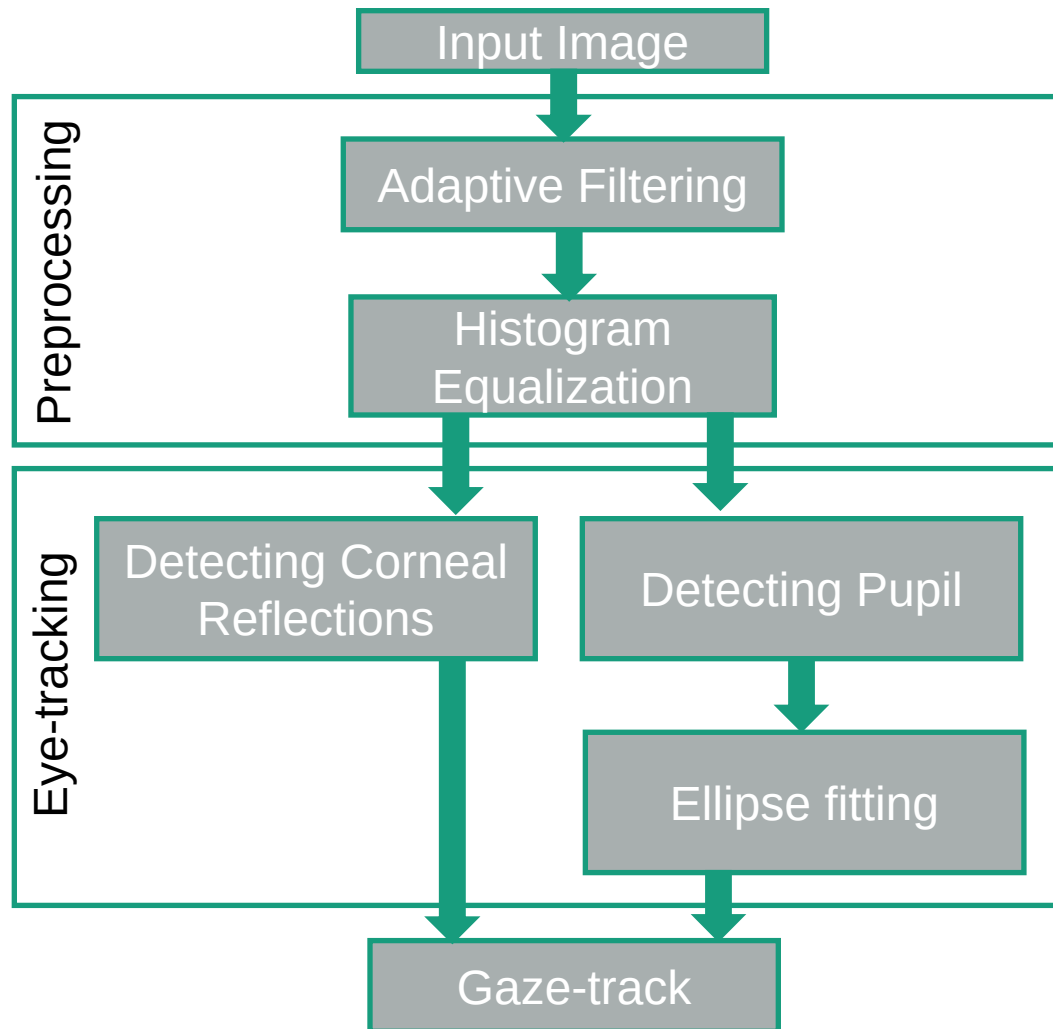
- Display: 640 x 480 pixels
- Viewing-area ( $\mu$ D): 10,2 mm x 7,7 mm
- Eyetracking camera: 128 x 96 pixels
- FOV (see-through): 26,5° x 17,2°
- FOV (info channel): 20° x 21,6°
- Accomodation distance: 750 mm
- See-through Transparency: 50 %
- Eye-motion box: 5,6 mm x 11,2 mm
- Weight: 198g





# Applications

## Eyetracker



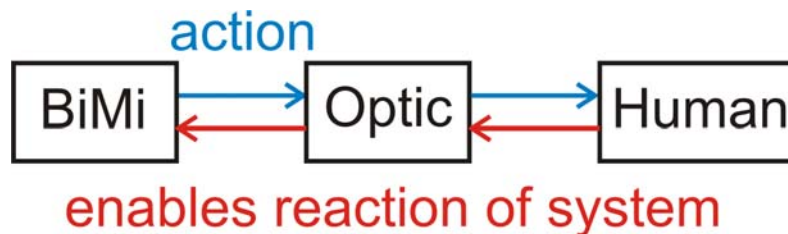
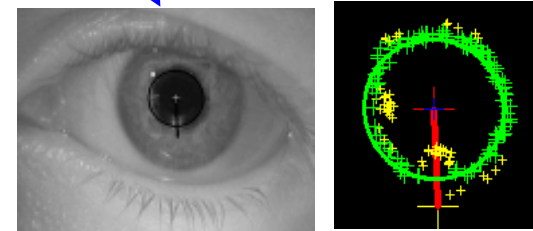
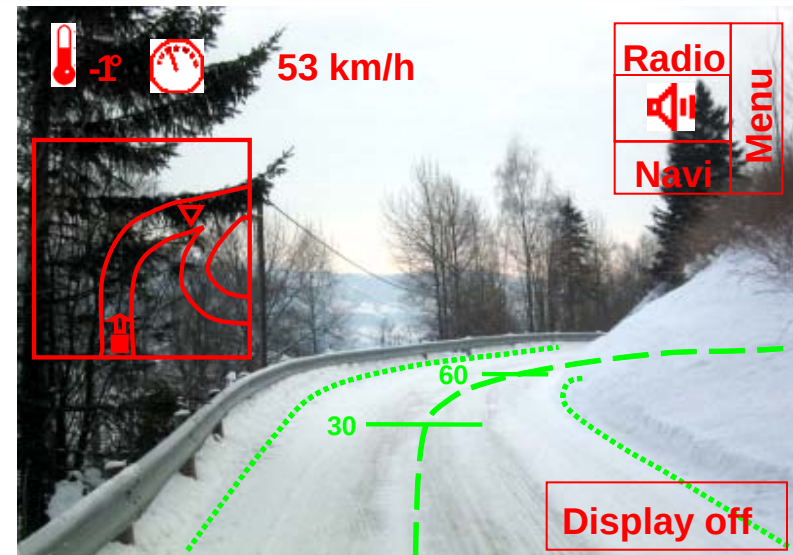
Input image



Detection of pupil (red) and reflections (green)

# Applications

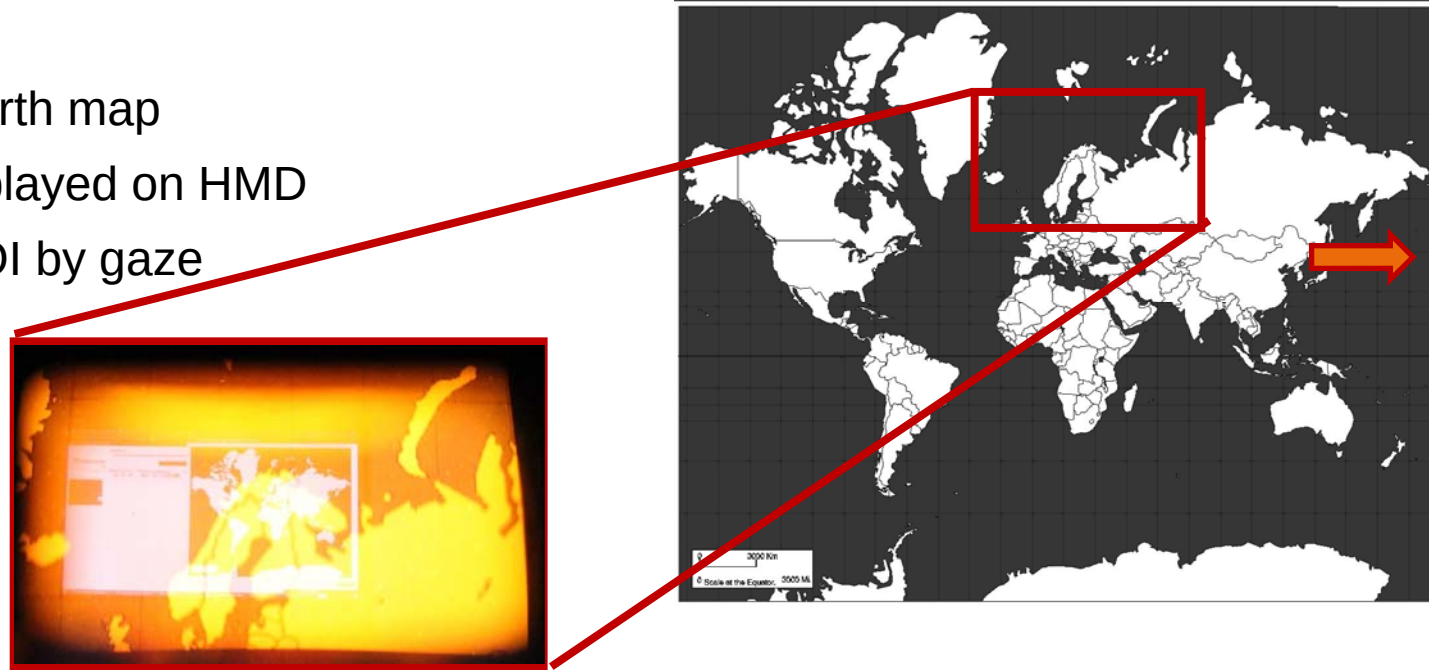
- Bidirectional display
  - Displays an image and detects another image on the same device
- HMD application
  - Tracking eye-movement for users sight and awareness
- Gaze-based human-display-interaction
  - Interactive augmented-reality



# Applications

## Worldmap

- Fullsize earth map
- ROI is displayed on HMD
- Moving ROI by gaze



Try this demo  
at booth #1371!

# Summary

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- Bidirectional OLED-Microdisplay
- Demonstrator OLED based binocular interactive see-through HMD is available
- Work was in parts sponsored by Federal Ministry for Education and Research of the German government

## Contact

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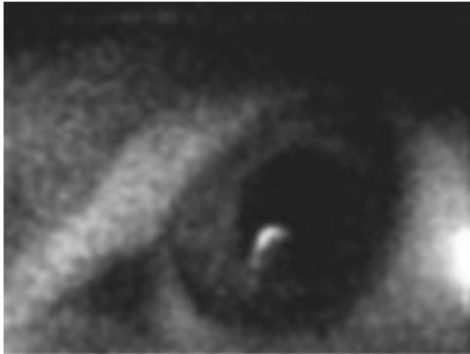
***Thank you for  
attention***

# Optical System

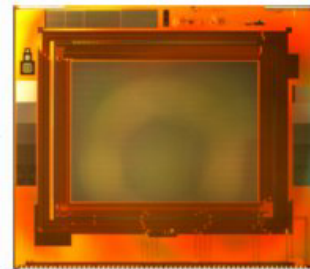
## HMD-Application

- See-through optics (beam-splitter, VIS transmissive mirror)
- Different imaging planes for display and camera
- Near-infrared illumination of eye scene

captured eye scene with 160x120 pixel



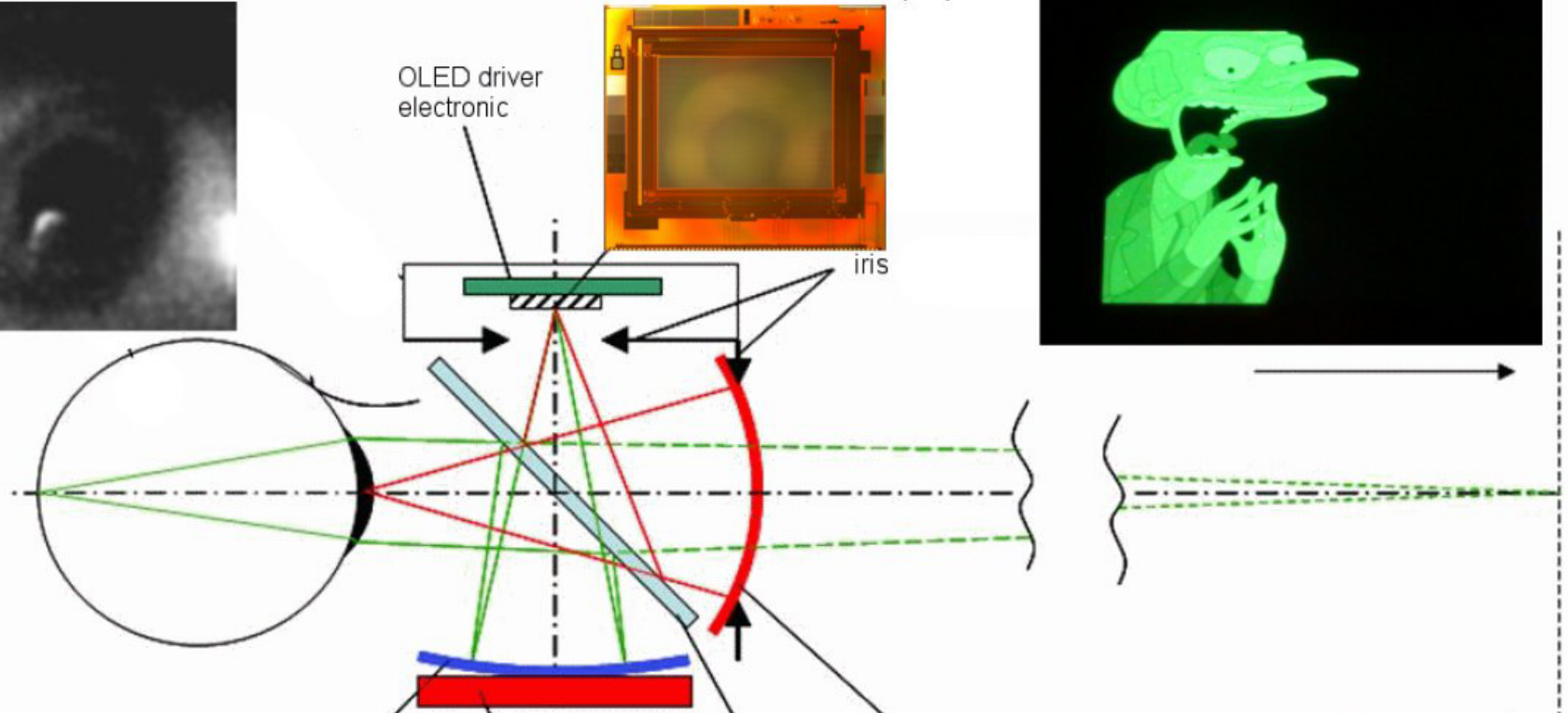
bidirectional OLED microdisplay



OLED driver electronic

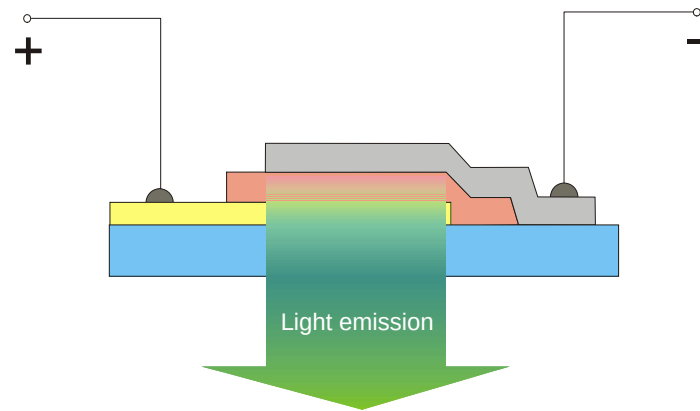
iris

virtual image



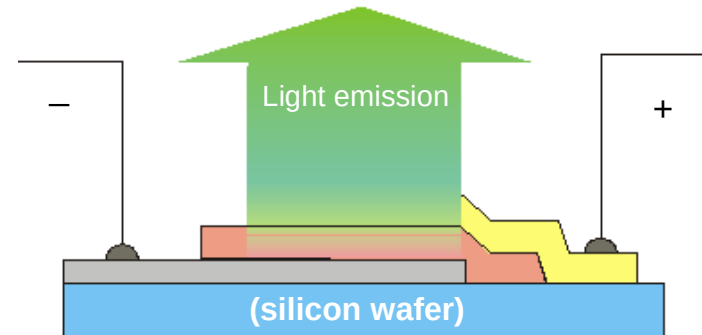


# Introduction to organic LEDs - **OLEDs**



**bottom-emitting**

- Lighting
- Medium and large display  $\Rightarrow$  TFT



**top-emitting**

- OLED-on-CMOS

