Automotive Interiors Innovation & Design Forum 2016
Future HMI trends - concepts and solutions for vehicle instrumentation
Dr. Heinz Abel, Head of Center of Competence, Continental Automotive GmbH
## Agenda

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## Agenda

1. Introduction
2. **Market trends for Interior applications**
3. Instrument Clusters
4. Head-up Displays (HUD)
5. Displays & Touch Devices
6. Outlook on Human Machine Interface for AD
The Phenomenon
Generation “Head-down”
Market & Design Trends
Influence of CE Devices on automotive solutions

Drivers increasingly demand the HMI experience from consumer electronics

Source: Thinkstock & Continental
Intelligent Driving
Change of Driver’s Tasks & Expectations

Source: Continental
Challenges for Future Human Machine Interface Concepts based on Megatrends

Paradigm Shift: Car as an entertainment and communication spot

New Values
- Traditional values are changing

Always on
- Strong need for seamless communication

Mobility expectations
- Car sharing
- Sustainability
- Automated Driving

Need for a holistic Human Machine Interface approach
Holistic Human Machine Interface…

- **User**
  - Needs
  - Preferences
  - Conditions

- **Environment**
  - Traffic situation
  - Infrastructure
  - Traffic member

- **Vehicle**
  - Maneuver
  - Position
  - Speed

**User – System interaction**
- Dynamic information management → prioritization, workload management
- Adaptation of output modalities
- Adaptation of functions & features

…leads to an inspiring driving experience
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Hybrid Instrument Cluster
Seamless display integration

Technical features
› Hybrid: large display + analogue gauges
› AMOLED technology integration
› Seamless surface design
› Optical bonding / plastic foil
› Illumination & decoration
› Black panel effect when power is off
› Decorative elements integrated

Source: Continental
Full Digital Instrument Cluster – Mercedes S-class
Human Machine Interface design

Technical Features:

- AM-TFT, 12.3 inch, I-IPS technology
- Full color display: 1440 x 540 x RGB pxl
- Premium line graphics controller
- High performance animations

High flexibility & variability

Source: Continental
Full digital Instrument Cluster – Volkswagen Passat

Human Machine Interface design

Technical features:

› AM-TFT 12.3 inch diagonal
› Full color display
› 1440 x 540 x RGB
› Platform graphics controller
› Continental toolchain for HMI development
› High performance animations

Source: Continental
Full digital Instrument Cluster and Center display
Human Machine Interface design new E-class, Mercedes Benz

Technical Features:
› AM-TFT 12.3 inch diagonal
› Full color displays
› Resolution 1920 x 720 x RGB
› Glass optical bonding
› Platform graphics controller
› Continental toolchain
› High performance animations

Source: Continental
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Status Quo for Windshield HUD and Combiner HUD
Head-up Displays in Series Production

<table>
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<tr>
<th>Audi 2010</th>
<th>BMW 2012</th>
<th>Daimler 2014</th>
<th>RSA</th>
<th>VW 2015</th>
</tr>
</thead>
</table>

**Market status for 2014:**
- **10 OEM's** offering Head-up-Displays for 19 different car lines
- WW market production volume HUD: more than 1,5 million units
- Virtual image size: ca. 6° x 2°

**Outlook for 2020:**
- **22 OEMs** offering HUDs for 49 different car lines
- WW Market production volume HUD: app. 8 million units
- Virtual image size: app. 10° x 5°

Strong market growth expected for HUD application in passenger vehicles

Source: Continental

© Continental AG

Interior Public

23 May 2016
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Next Generation HUD
Innovative Solution

Augmented Reality

Augmented Reality Head-up-Display

Highlights:
› Lane Departure Warning
› ACC
› ACC Gap Setting
› Navigation

Head-up-Display

Dialogue between Driver & vehicle – ergonomically wise optimized & safe

Source: Continental

16
Two image planes

- Status information is presented in the near field image plane (2,4m).
- Augmentation to be shown in the far field image plane (7,5m).
- In case that augmentation is not possible, the near field image plane takes over the content.
- Only objects behind the AR image plane can be augmented.

Source: Continental
AR-HUD Device and Optical Performance

Overview of the Optical Layout

Description / Actual Technical Details:

› **1st Layer**: optimized DMD PGU
› **2nd Layer**: optimized TFT PGU
› **Image size:**
  1st Layer: 10° x 4° (+ 0,8° Tolerance) / Look Down: 2,35°, Look-O.: 0
  2nd Layer: 5° x 1° / Look Down: 5,95°, Look-Over: 0°

Optical Data

› Projection distance: 7,5 m and 2,4 m
› Using DMD Chip: 0,3” with 854 x 480 pixel
› Using TFT: 1,8” with 480 x 240 pixel
› Eyebox dimension: X = 140 mm & Y = 60 mm
› Brightness: > 10.000 cd/m²
AR-HUD Device and Optical Performance
Opto-mechanical Design of the AR-HUD Device
Augmented Reality Head-up-Display System approach including AR-Creator

AR-HUD MD/HW/SW

ADAS-Camera

Radar/SCC

Power Management HW/SW

Vehicle link

AR-Creator connected
› Driver's view
› Sensors e.g. (camera and radar)
› GPS-Positioning
› eHorizon

Source: Continental

© Continental AG
Augmented Reality Head-up-Display Prototype Vehicle

- Connected (ADAS, eHorizon, GPS Instrumentation)
- Visualisation of 2 images planes
- Ready-to-market 2019
- Powerful AR creator chipset (4 core processor, 1.2 Ghz)

Source: Continental
### Agenda

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Human Machine Interface Design
Technology influences Interior design

- Displays introduced in ~1990+
- Touch screens introduced ~2005+
- Mobile industry influences strongly automotive HMI
- Touch displays take over central control element
- Buttons mostly disappear, design buttons remain
- Curved Designs will be introduced in ~2020+
- Displays more or less everywhere
- Proximity and gestures are entering automotive market

Source: Continental
23 May 2016
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## Technology Toolbox
### Displays

<table>
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<tr>
<th>Best Cost Display Technology</th>
<th>Mainstream Display Technology</th>
<th>Future Display Technology</th>
</tr>
</thead>
<tbody>
<tr>
<td>TN Panel</td>
<td>IPS Panel</td>
<td>OLED Panel</td>
</tr>
</tbody>
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- **TN Panel**
  - Acceptable Contrast
  - Focus affordable instrument cluster

- **IPS Panel**
  - High Contrast over viewing angle
  - Preferred for center displays
  - Curvature ~1000mm

- **OLED Panel**
  - Superior Contrast
  - Consideration for new designs
  - Curvature <100mm possible

Source: Continental
Technology Toolbox

Touch Screens

<table>
<thead>
<tr>
<th>Out-of-focus Touch Technology</th>
<th>Mainstream Touch Technology</th>
<th>Future Touch Technology</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Bezel Design</strong></td>
<td><strong>Seamless Design</strong></td>
<td><strong>Seamless Design Curved</strong></td>
</tr>
<tr>
<td>Integration behind a bezel</td>
<td>Design glass with black print</td>
<td>Curved design lens cover</td>
</tr>
<tr>
<td>Glass-Glass or OGS</td>
<td>Glass-Glass or OGS</td>
<td>Laminated touch sensor foil</td>
</tr>
<tr>
<td>Mechanical buttons</td>
<td>Capacitive button integration (optional)</td>
<td>Capacitive button integration (optional)</td>
</tr>
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Source: Continental

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Technology Toolbox
Surface Design

Out-of-focus Front Surface

Flat Design
- Soda Lime glass with film on top
- Aluminosilicate glass (AlSi) chemical strengthened
- Anti-Glare (AG)
  Anti-Reflection (AR)
  Anti-Fingerprint (AFP)

Mainstream Front Surface

2.5D Design
- Aluminosilicate glass (AlSi) - chemical strengthened
- AG, AR and AFP possible
- Very good optical performance
- High valuable touch and feel

Next Step Front Surface

3D Design
- Aluminosilicate glass (AlSi) - chemical strengthened
- AG, AR and AFP possible
- Very good optical performance
- High valuable touch and feel
- Complex production processes

Source: Continental

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## Technology Toolbox
### Proximity / Gesture Design

<table>
<thead>
<tr>
<th>Short Range Proximity Gestures</th>
<th>Mid Range Proximity Gestures</th>
<th>Long Range Proximity Gestures</th>
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<tbody>
<tr>
<td><strong>Hovering</strong></td>
<td><strong>Large Object Detection</strong></td>
<td><strong>Object recognition</strong></td>
</tr>
<tr>
<td>› Up to 20-30mm</td>
<td>› Up to 100-150mm</td>
<td>› Up to 150..300mm</td>
</tr>
<tr>
<td>› x,y,z coordinates</td>
<td>› Distance / Zone information / Simple Gesture Detection</td>
<td>› Hand details are resolved</td>
</tr>
<tr>
<td>› Single Finger</td>
<td>› Only Large Hand</td>
<td>› Camera based solution</td>
</tr>
<tr>
<td>› Capacitive Technology</td>
<td>› IR Technology</td>
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Source: Continental

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Technology Toolbox

Use case: Gesture Recognition

- finger swipe up/down
- finger swipe left/right
- hand swipe up/down
- hand swipe left/right
- hold
- virtual finger tap

Source: Continental

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Technology Toolbox
Haptic Feedback

Mainstream
Haptic Feedback

Push Haptic
› Confirmation of command
› Real button function
› Force measurement
› Configurable haptic profile (force and strength)

Advanced
Haptic Feedback

Search Haptic
› Feedback during “search for button”
› Programmable feedback during transition from one button to another
› Only coordinate measurement
› Feedback profile freely configurable

Future Opportunities
Haptic Feedback

Haptic Display Controls
› Supports new controls on displays
› Enables new design opportunities: Example rotary knob profile
› Force and Feedback freely configurable

Source: Continental
Technology Toolbox
Importance of Haptic Feedback

Efficiency Evaluation

Average operating time [s]

With haptic FB  Without haptic FB

Source: Continental

23 May 2016
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Haptic Feedback on Displays
Feel the Function

› **Haptic feedback** supports interaction with touch surfaces

› **Search-haptics** allow to differentiate virtual buttons without looking at the display

› **Force-sensing** and **haptic feedback** prevent from activating features accidently

› **Haptic profiles** can be dynamically and individually adapted to customer requirements

› Haptic Feedback enables **new controls on touch displays**

Source: Continental

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Intuitive Human Machine Interaction
Example: Curved Center Stack

Source: Continental
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Automated Driving – Evolutionary Steps

Overview

Roadmap

Backend Systems

Source: Continental
Outlook on HMI for Automated Driving
Visual Driver Assistance

Automated Driving requires an Human Machine Interface which covers the Driver-in-the-loop behavior (depending on AD level).

A Holistic Human Machine Interface approach enhances drivers trust concerning automated Driving (Driver Assistance).

AR-HUD will be a part of future Human Machine Interaction in passenger vehicles – a dialogue between driver and vehicle is ergonomically supported through augmentation.

Full digital clusters / Center displays showing high flexibility while changing between driver mode & AD mode.

Touch with haptic Feedback and gesture control as part of the holistic Human Machine Interface is supporting input of information with high flexibility.
Thank you very much for your attention!