Human-Machine interaction in vehicles

From first vehicles to autonomous cars

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# a fun introduction
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Presentation

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Field of work:
Human-machine interaction in vehicles, focusing on multimodal interaction
Measuring cognitive load of driver‘s
Development of driving simulation systems (Nervteh)
HMI – Human-Machine interaction

- Engineering
  - information sciences
  - information representation
  - 2D/3D graphics
  - computer science
  - electrical engineering
    (analog/digital)
  - physics
  - mechanical engineering

- Technology

- Human sciences
  - semiotics
  - cybernetics
  - communications theory
  - anthropology
  - sociology
  - (cognitive) psychology
  - physiology
  - kinesiology
  - bio-mechanics

- Design
  - graphic design
  - interaction design
  - audiodesign
  - industrial design
  - architecture
HMI – Human-Machine interaction
Touchscreens
Free hand gesture control
Gesture control in BMW 7
Ultrasonic haptic feedback
Ultrasonic haptic feedback
Multimodal interaction
Multimodal interaction
Drivers cognitive load

CONTROLLING IVIS

PSYCHOPSYLOGICAL RESPONSE

INDIRECT MEASURES

SUBJECTIV REPORTING

LOADING
Goals of in-vehicle HMI research
Example of a HMI research study
A comparison of vehicles user interfaces
Comparing touchpad-based and free hand gesture input to common used interaction interfaces

Can touchpad and free hand interaction offer better user experience?
Driving Simulator Study

- High-performance driving simulator
- Triple screen covers 120° horizontal field of view
- Software enables creating of custom driving scenarios and collecting driving data
User interface

• Visual output: Head-Up display

• Input:
  • Leap motion controller – free hand gesture recognition
  • Android smartphoone – touchpad input
  • Fanatec Porsche simulator wheel – button input
Study Design

• 30 participants (16 male, 14 female)

• Two groups:
  • A – easy traffic environment
  • B – difficult traffic conditions

• Each participant performed a set of tasks on each input device while driving

<table>
<thead>
<tr>
<th>Task ID</th>
<th>Description</th>
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<tbody>
<tr>
<td>Set 1</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Power station batteries</td>
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<tr>
<td>2</td>
<td>Next temperature on 22 steps</td>
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<tr>
<td>3</td>
<td>On/Off WiFi power</td>
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<td>4</td>
<td>Change the seat heating to &quot;low&quot;</td>
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<td>5</td>
<td>Check unanswered calls</td>
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<td>6</td>
<td>Play the song Waka Waka from Shakira</td>
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<td>7</td>
<td>Call Doris June</td>
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<tr>
<td>Set 2</td>
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<tr>
<td>1</td>
<td>Set the temperature to 24 degrees</td>
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<tr>
<td>2</td>
<td>Check your average speed</td>
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<td>3</td>
<td>Disable WiFi network</td>
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<td>4</td>
<td>Change radio station to FM 90.6</td>
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<td>5</td>
<td>Set the fan speed to 2</td>
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<td>6</td>
<td>Navigate to Maribor</td>
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<td>7</td>
<td>Play the song Baby from Justin Bieber</td>
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<td>Set 3</td>
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<tr>
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<td>Set the seat heating to &quot;off&quot;</td>
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<tr>
<td>2</td>
<td>Check fuel level</td>
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<td>3</td>
<td>Set the temperature to 23 degrees</td>
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<td>Set the fan speed to 1</td>
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<td>Change radio station to FM 94.5</td>
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<td>Play the song Hurt from Johnny Cash</td>
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<td>7</td>
<td>Call Dajan Sabek</td>
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</tbody>
</table>

Figure: Sample task set
User Experience Evaluation

- User experience was evaluated with the UEQ (User experience questionnaire)
- Each participant answered the questionnaire immediately after finishing the task set with one of the devices
- Slovenian version of the UEQ was used
- Attractiveness
- Pragmatic quality: Perspicuity, Efficiency, Dependability
- Hedonic quality: Stimulation, Originality

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<tr>
<th>1</th>
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Results (1/2) - Easy Driving

1 - Button on steering wheel

2 – Free hand interaction

3 – Touchpad interaction
Results (2/2)

1 - Button on steering wheel

2 – Free hand interaction

3 – Touchpad interaction
Conclusion

• Overall the well-established interaction with button on the steering wheel shows the best results

• Free hand interaction
  • very good ratings for its originality
  • has perspective to be used in vehicles
  • current implementation is not efficient

• Touchpad
  • above average with its current implementation
  • could be used as part of a multi-modal user interface

• Future work
  • Impact of interface on the drivers safe driving behavior and traffic safety
Behavior research

Autonomous driving test of Ford

Driver was hidden behind a driving seat

Research on how the public reacts on driverless cars
The past
The future?
Augmented reality in vehicles
Future of autonomous driving
What do you think?