Workshop

Strategies and assets for the HMI design in semi and fully autonomous vehicle

Roberto Montanari

2017 - HUMANIST SUMMER SCHOOL Human Factor issues for the future car autonomous experience

Vigo, 13-14-15 September

Summary

- The HMI
- Some steps in the HMI evolution
- Design assets in fully and/or partly autonomous driving
- Design principles and their application to the autonomous vehicle perspective
- Design challenges
- Design tools
- Appendix: design thinking tool

The HMI

Human Machine Interface

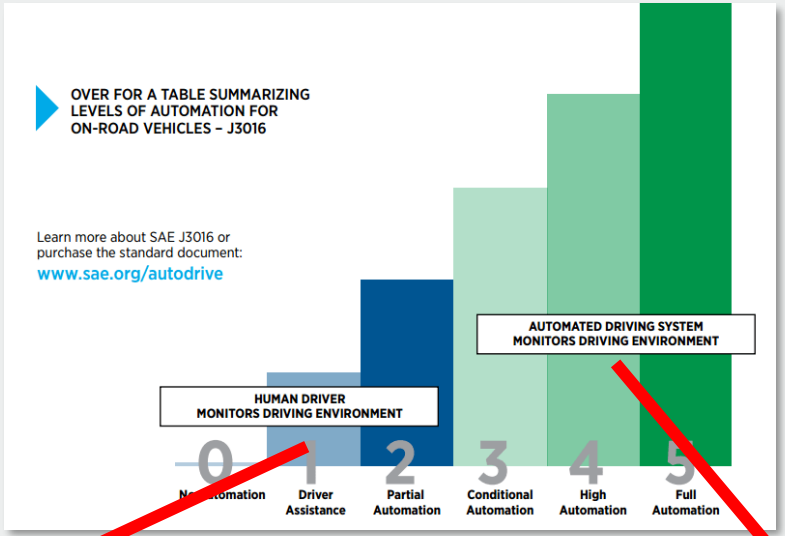
http://www.bbc.co.uk/programmes/p01d504x/p01d56xj

Human Machine Interface

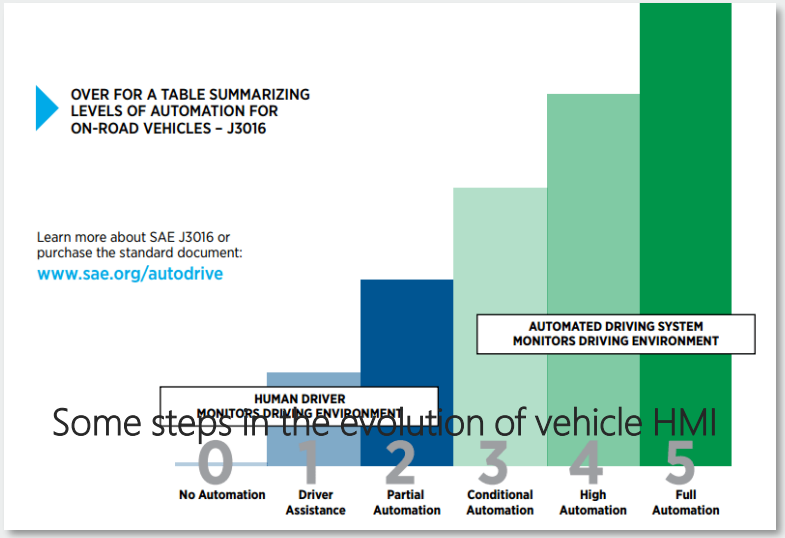
http://www.team-bhp.com/forum/vintage-cars-classics-india/73297-dashboard-pictures-vintage-classic-cars.html

The scenario: primary and secondary commands

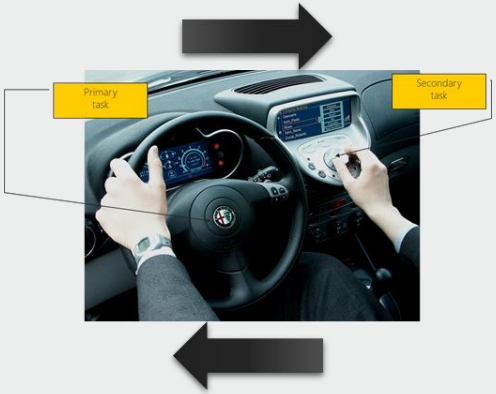
The automation path from HMI perspective (1/2)



The automation path from HMI perspective (2/2)

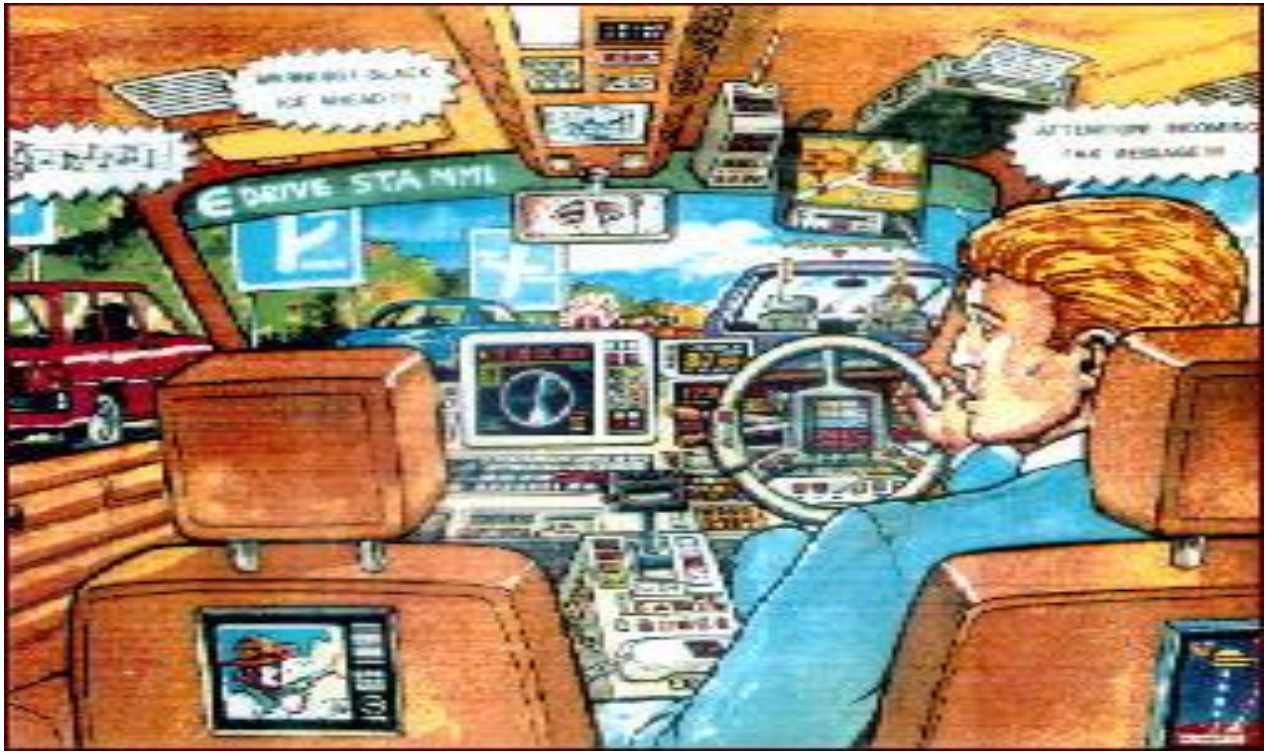


Some steps in the evolution of vehicle HMI



Some steps in the HMI evolution

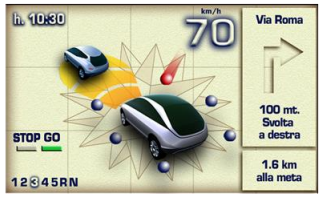
First step… buttons per functions



Second step… integration

Lancia Dialogos 1998

Lancia NEA
2001



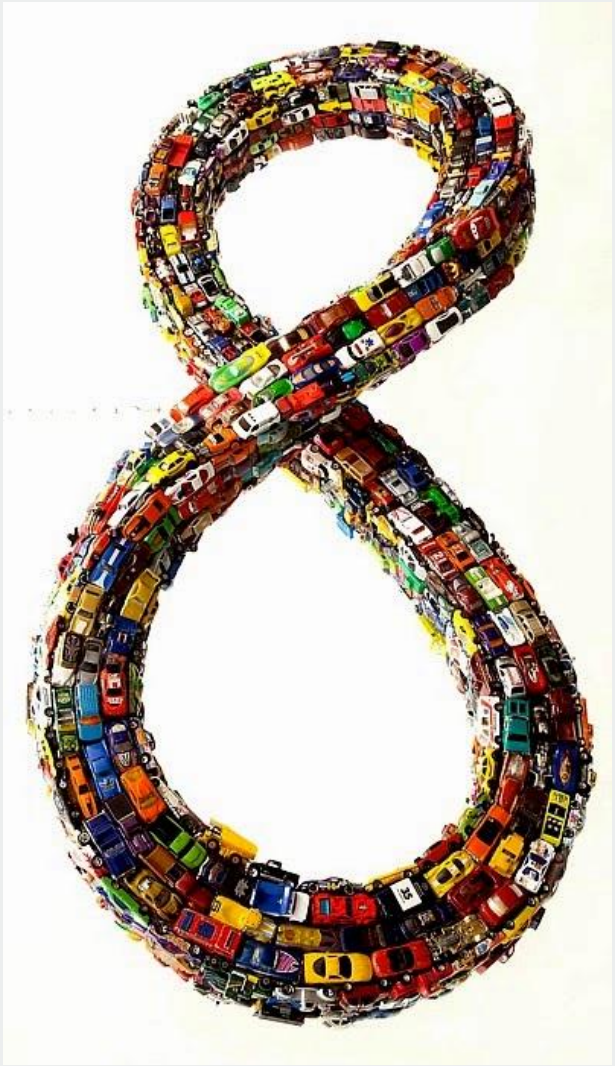
Third step – adaptiveness

- In-vehicle Human Machine Interface (HMI), adaptive in real-time to the driving and driver conditions

- Integration into a working car of an HMI designed around users, iteratively assessed in virtual simulator and real roads

Fourth steps

- Fully multimodality in the interaction, i.e. vocal, visual, haptic, gesture based and eye-tracked seamlessly



Fifth one (CES 2017): new frontiers

https://www.formtrends.com/top-mobility-tech-announcements-ces-2017/

Connectivity

What is happening in HMI

Car Analytics and connectivity

Car adaptiveness

Ironies of Automation (Bainbridge, 1983)

The more complex an automated system is, the more important the role of the human operator becomes.

Automation takes over tasks that humans find annoying or are bad at.

- But: Operator has to monitor if the systems is doing the right thing

The more reliable the automated system, the lesser the human has to intervene and correct the automation.

- But: The lesser the human has to intervene, the harder it will be

Source: K. Wiedemann, N. Schömig - Challenges of vehicle automation A human factors perspective

Design assets in fully and/or partly autonomous driving

How to display automation

Volvo IntelliSafe Auto Pilot

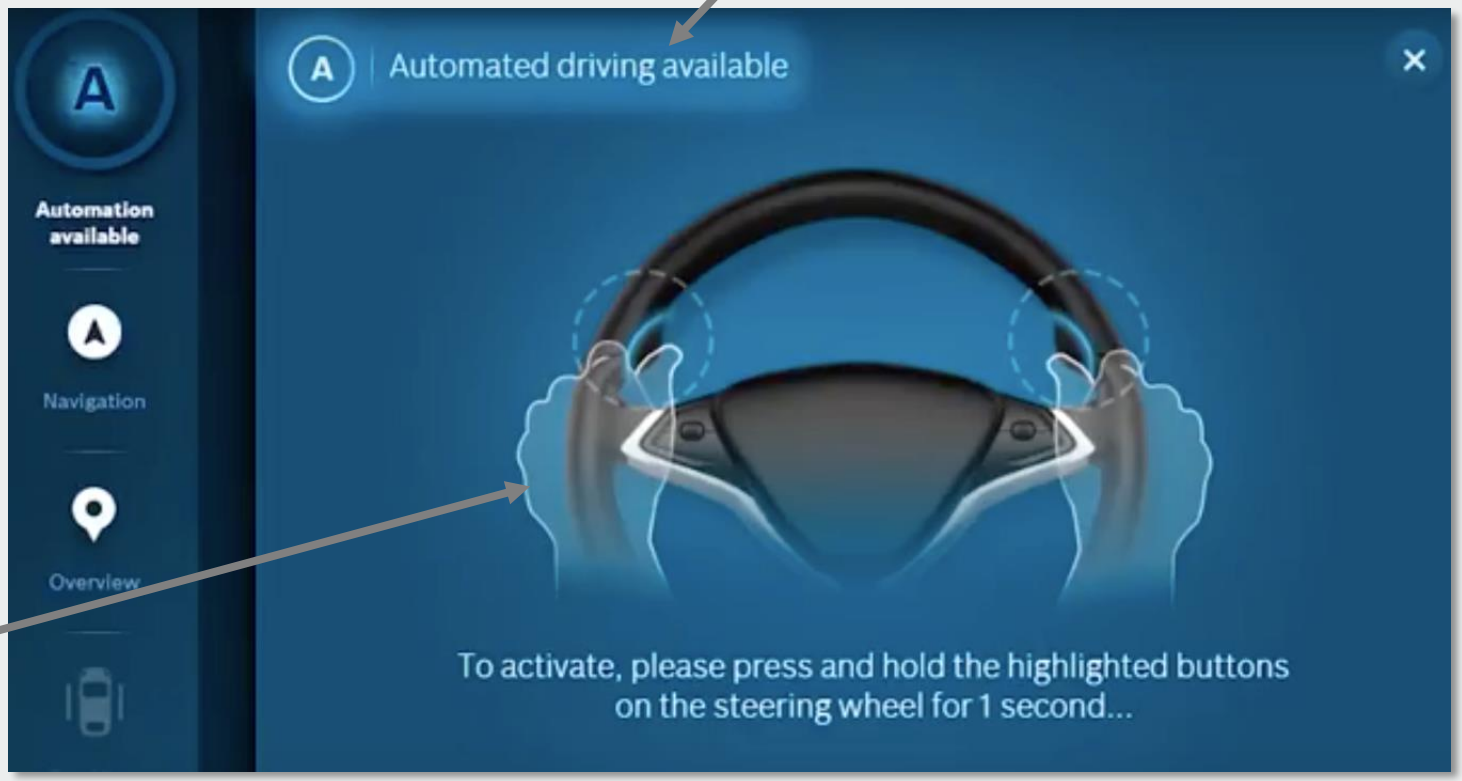
Automation state visualization

Short term information

https://www.youtube.com/watch?v=xYqtu39d3CU

Bosch – test pilot: NIT

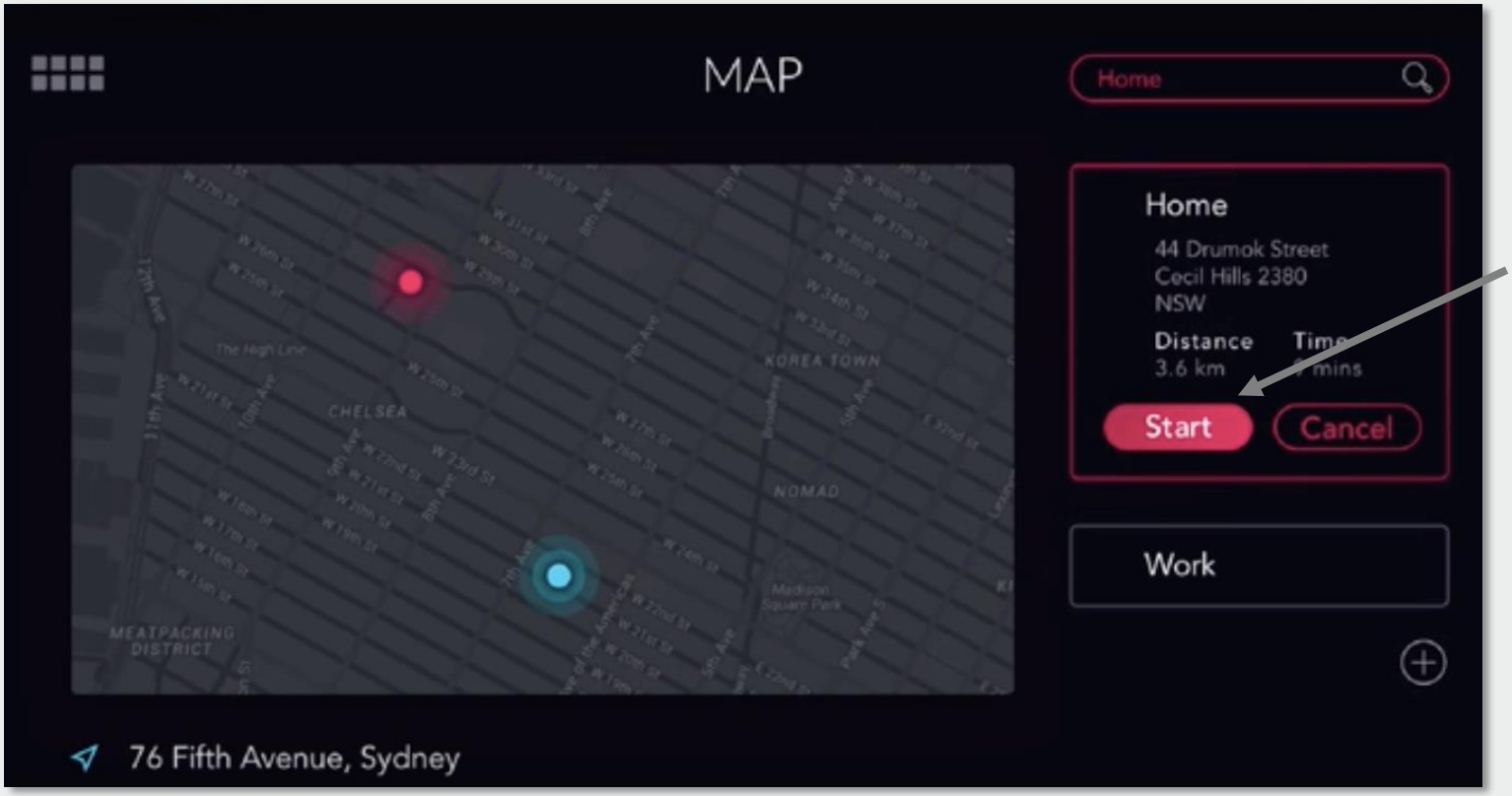
Suggestion for handover



Info on activavtion

https://www.youtube.com/watch?v=USrQgSKawFM

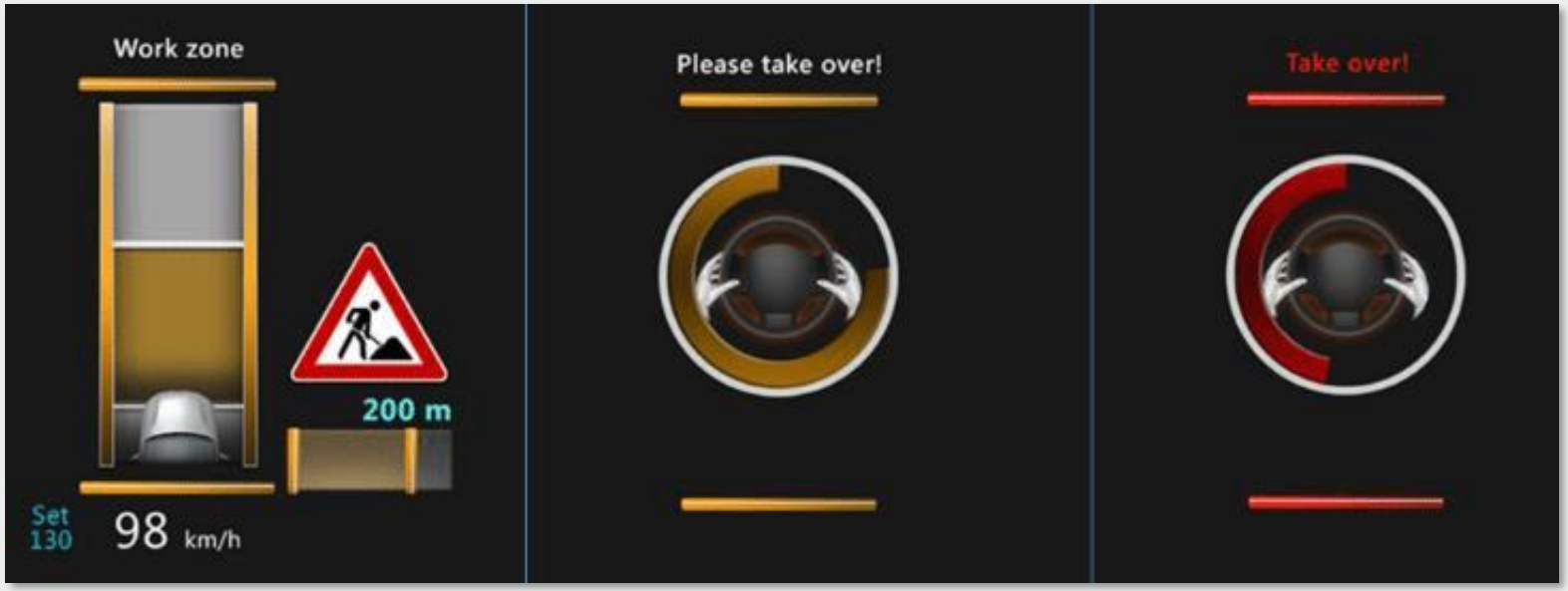
Fable: autonomous driving interface concept



https://www.youtube.com/watch?v=4iMr94ugW6E

Take Over Request: Design solutions

Transition design: Take Over Request



Explanation of the reason of take over
(in order to make the driver aware of the system capabilities)

Countdown for take over

Urgent take over needed
(the colour turns into red to highlight the urgency)

Forser, Y., et al., (2016), Your Turn or My Turn? Design of a Human-Machine Interface for Conditional Automation

Transition design: Take Over Request

HMI with automation scale and automation monitor;

HMI with message field faded in.

Elements of basic TOR: On-Screen Warning + acoustic gong;

Extended TOR: Mobile phone integrated, brake jerk.

V. Melcher, S. Rauh, F. Diederichs, H. Widlroither, W. Bauer, (2015) Take-Over Requests for automated driving

Design principles and their application to the autonomous vehicle perspective

Principles and rules for designing interfaces (Norman)

- Visibility
- Mapping- Proximity/compatibility
- Affordance and constrain
- Feedback
- Conceptual mode

Design guidelines for automated vehicles

Class	Guidelines	Reference
Human-automation interaction	Avoid as possible supervisory task in the interaction with highly automated vehicles	Endlsey (1995)
	Develop an efficient interaction for authority transition, considered as a trade-off between SA, driving comfort and workload level	Hancock (2013)
	Build a coherent mental model between human and automation	Lee (2004)
	Measure "Trust in automation" as key factor for an efficient driving performance	
Multimodal HMI	Combine in an accurate way the multimodality strategies (temporally cascaded, redundant, fused)	Muller (2010)
	Multimodal HMI can reduce temporal effort, but add cognitive one: evaluate the use of multimodality due to the need	Weinberg (2010)
	Combine different evaluation strategies to evaluate multimodality and adapt general usability guidelines for in-vehicle HMI	
	Use of "information mirroring" (e.g. on HUD or mobile device) can improve global performance	
	Ensure learnability and visibility of the interfaces	
Takeover request (TOR)	TOR can be mirrored on HUD	Kim (2009)
	The use of ambient lights signals can improve the takeover performance	Kelsch (2015)
	Develop a flexible and adaptive strategy for information visualization of TOR	Flemisch (2011)
	Develop accurate graphical features (e.g. recognizable icon and solid colour coding) can improve the takeover performance	Larsson (2015)
	Haptic feedback (e.g. vibrotactile seat) can help the driver to come back into the loop)	Bazilinskyy (2017)
	Use of other multimodal approach (e.g. visual and audio) can improve the takeover performance	

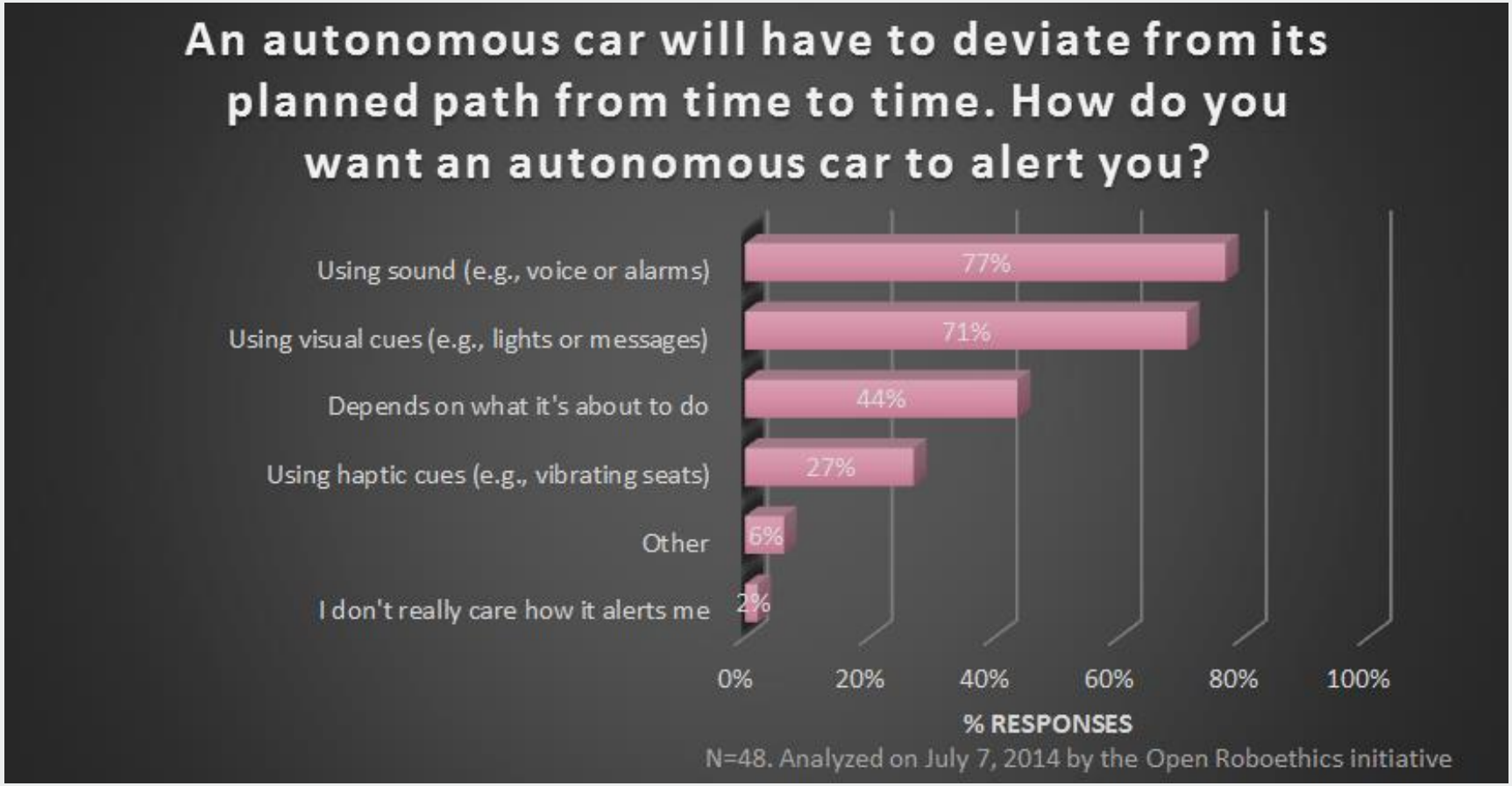
Time for Take Over

- Several experiments show that when there is a shorter take over request time, the users decide very more quickly, reacting faster, but normally with a worse quality

- Furthermore, when there is a decrease of the take over request time "*the gazes in mirrors and shoulder checks decrease, the accelerations increase, and the brake is used excessively*" (Gold C. et al, 2013).

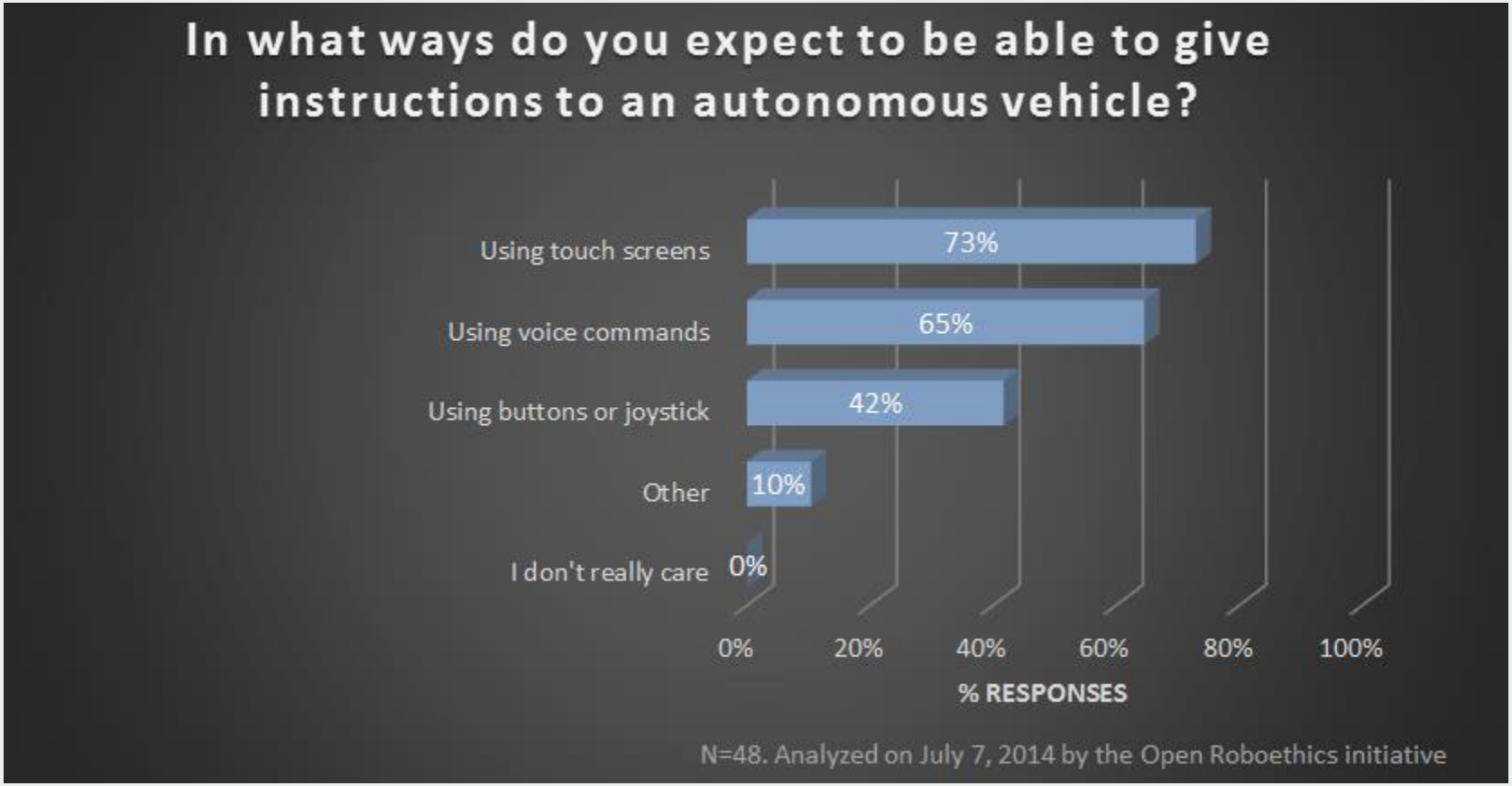
- Studies prove that when the driver is distracted, the effects of automation are still evident with 7s take over request time (Gold C. et al, 2013).

How do you want to interface with your autonomous car? (1/3)



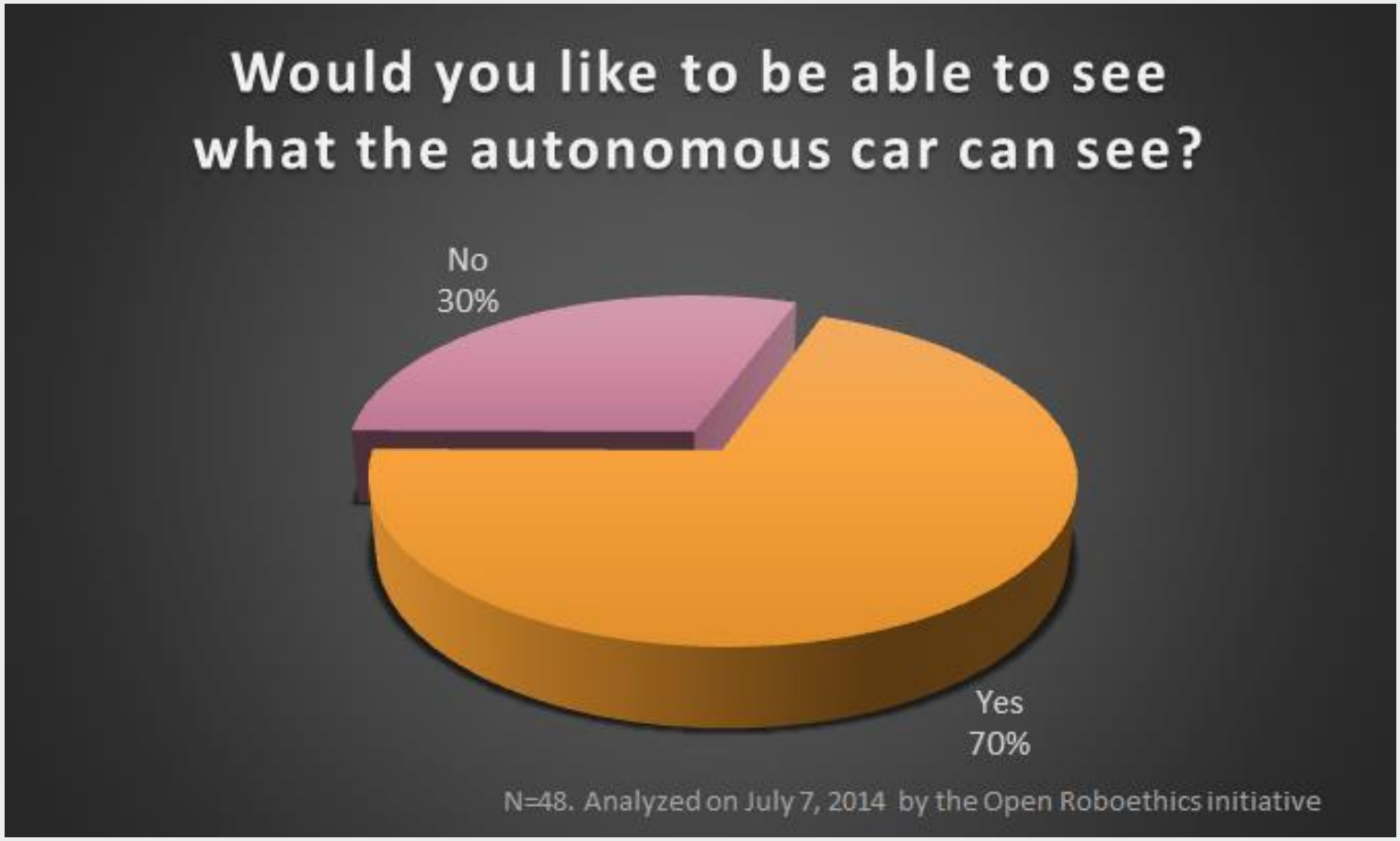
Source: Open Roboethics Initiative 2014 (http://robohub.org/how-would-you-like-to-interface-with-your-car-reader-poll-results/)

How do you want to interface with your autonomous car? (2/3)



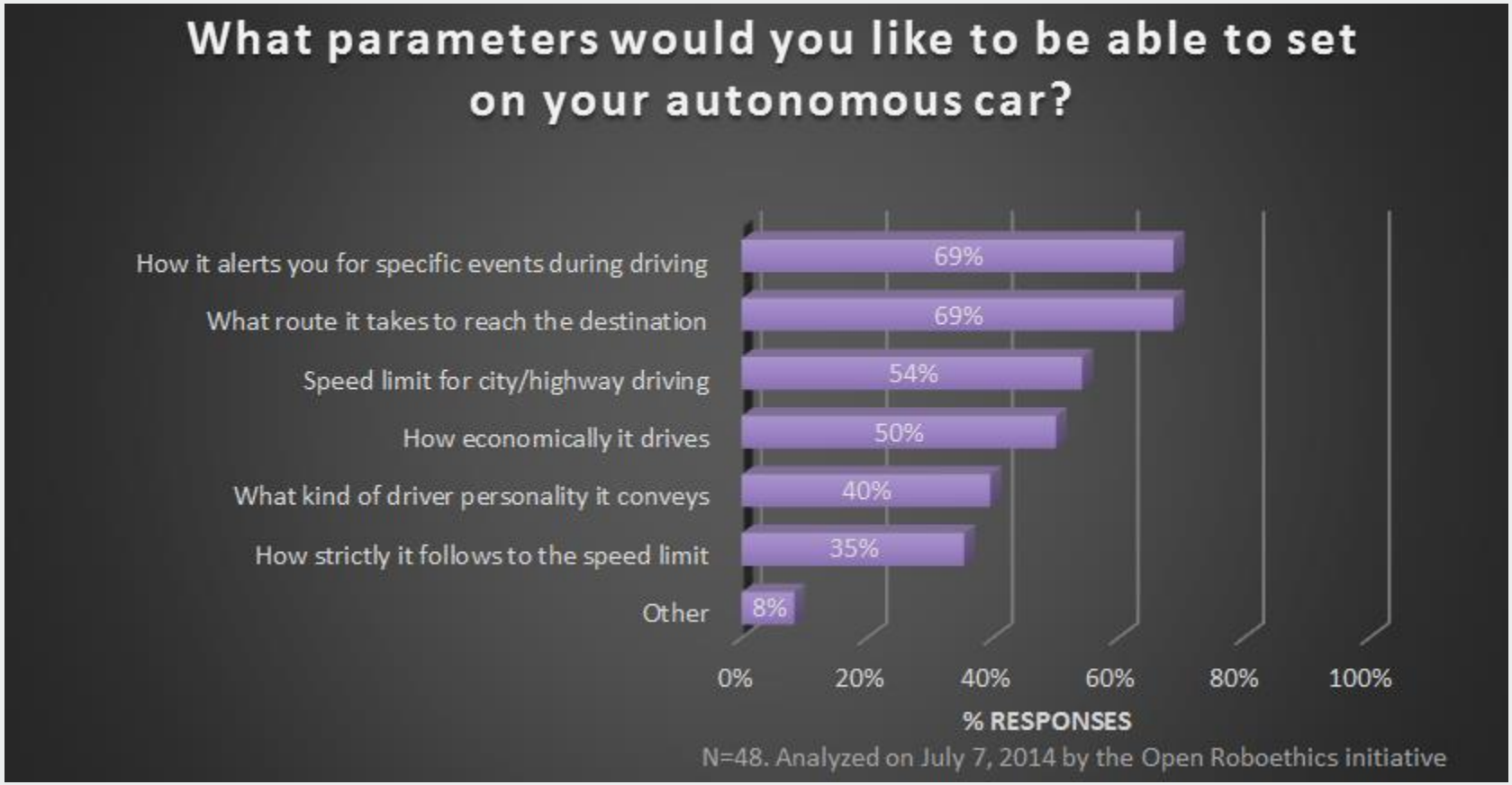
Source: Open Roboethics Initiative 2014 (http://robohub.org/how-would-you-like-to-interface-with-your-car-reader-poll-results/)

How do you want to interface with your autonomous car? (3/3)



Source: Open Roboethics Initiative 2014 (http://robohub.org/how-would-you-like-to-interface-with-your-car-reader-poll-results/)

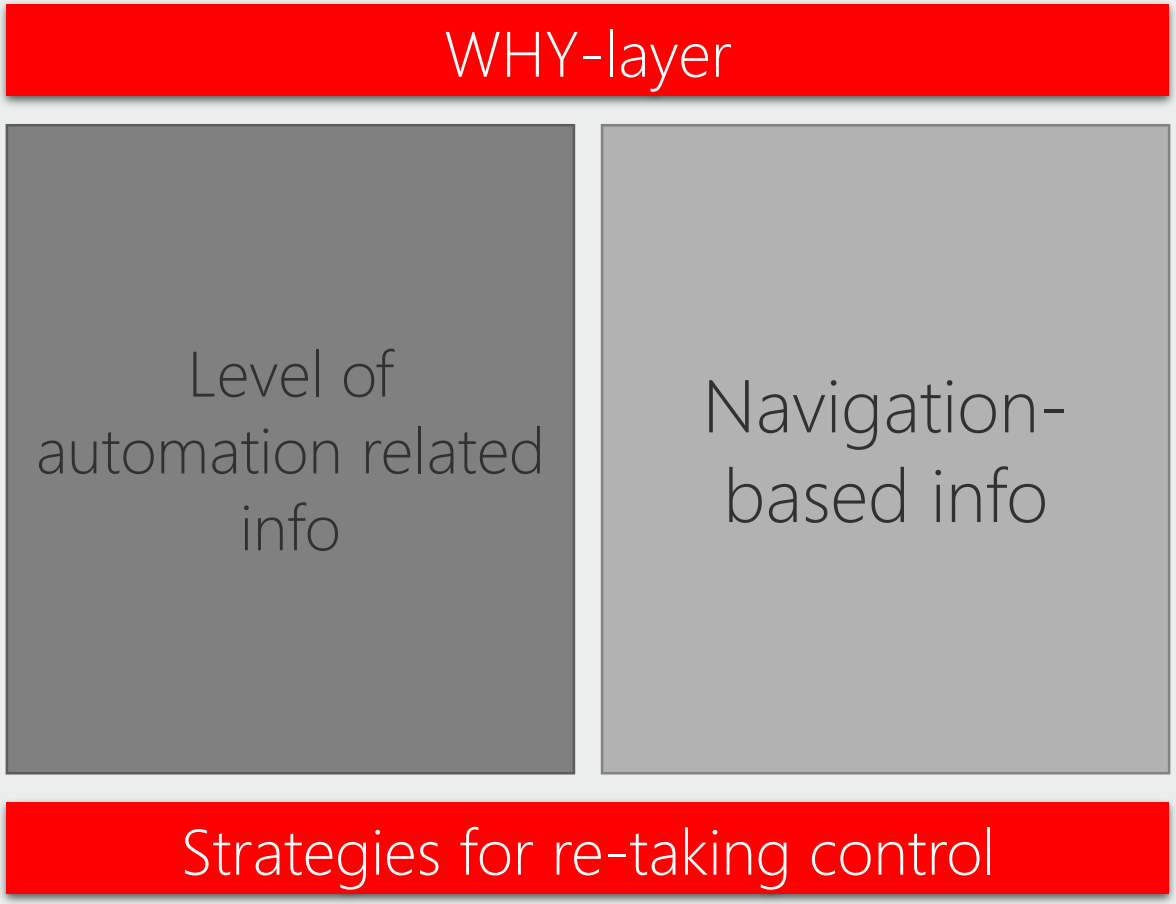
How do you want to interface with your autonomous car?



Source: Open Roboethics Initiative 2014 (http://robohub.org/how-would-you-like-to-interface-with-your-car-reader-poll-results/)

Why layer – Gowda et al. 2014

Nikhil Gowda et al. (2014): major feature of such HMIs: (i) who was in control (the car or the driver), (ii) information on driver status, (iii) core of the dashboard is the navigation system.



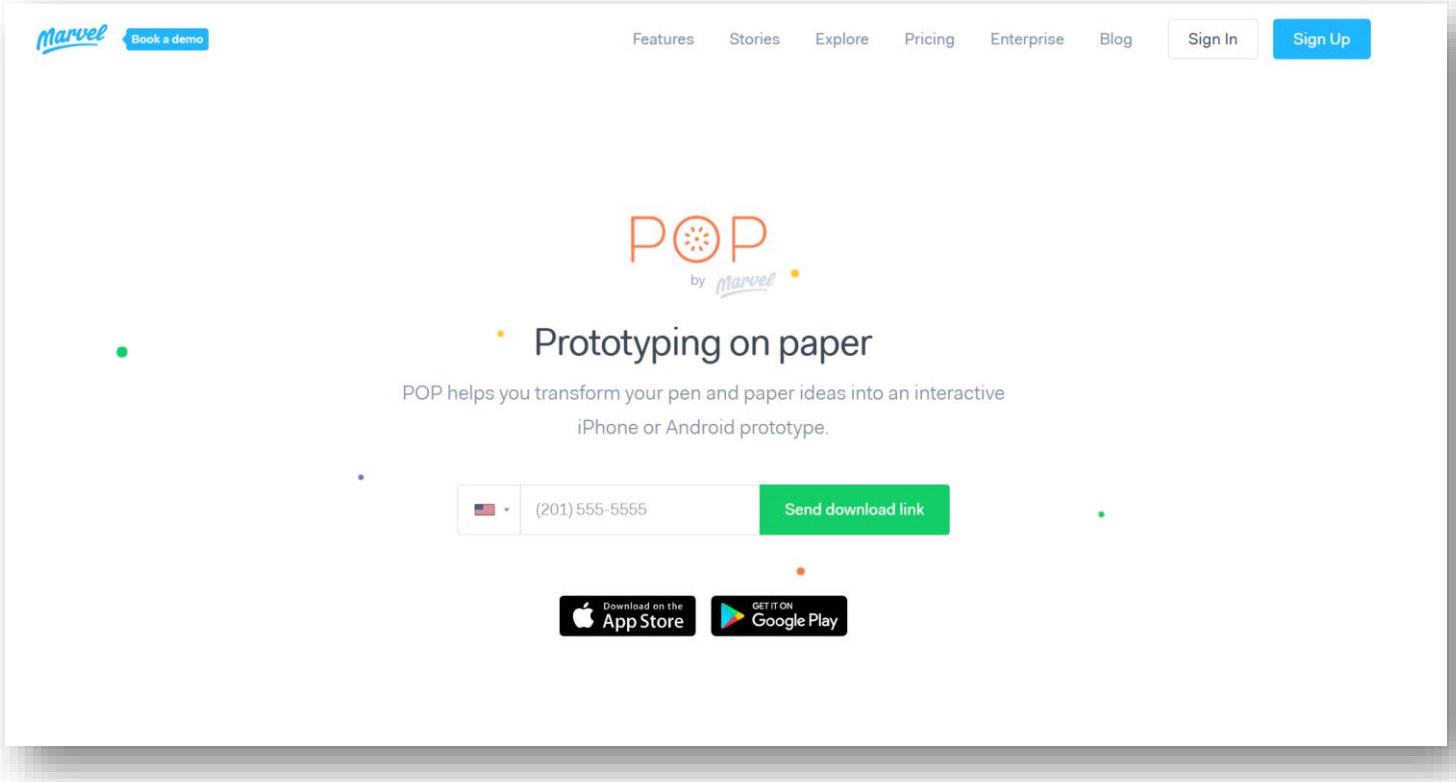
Design challenges

Design challenges

- #1 - Design trustworthy automation
- #2 – Transition design

Prototyping HMI

POP (https://marvelapp.com/pop/): through away prototyping



RE:Lab

Design thinking

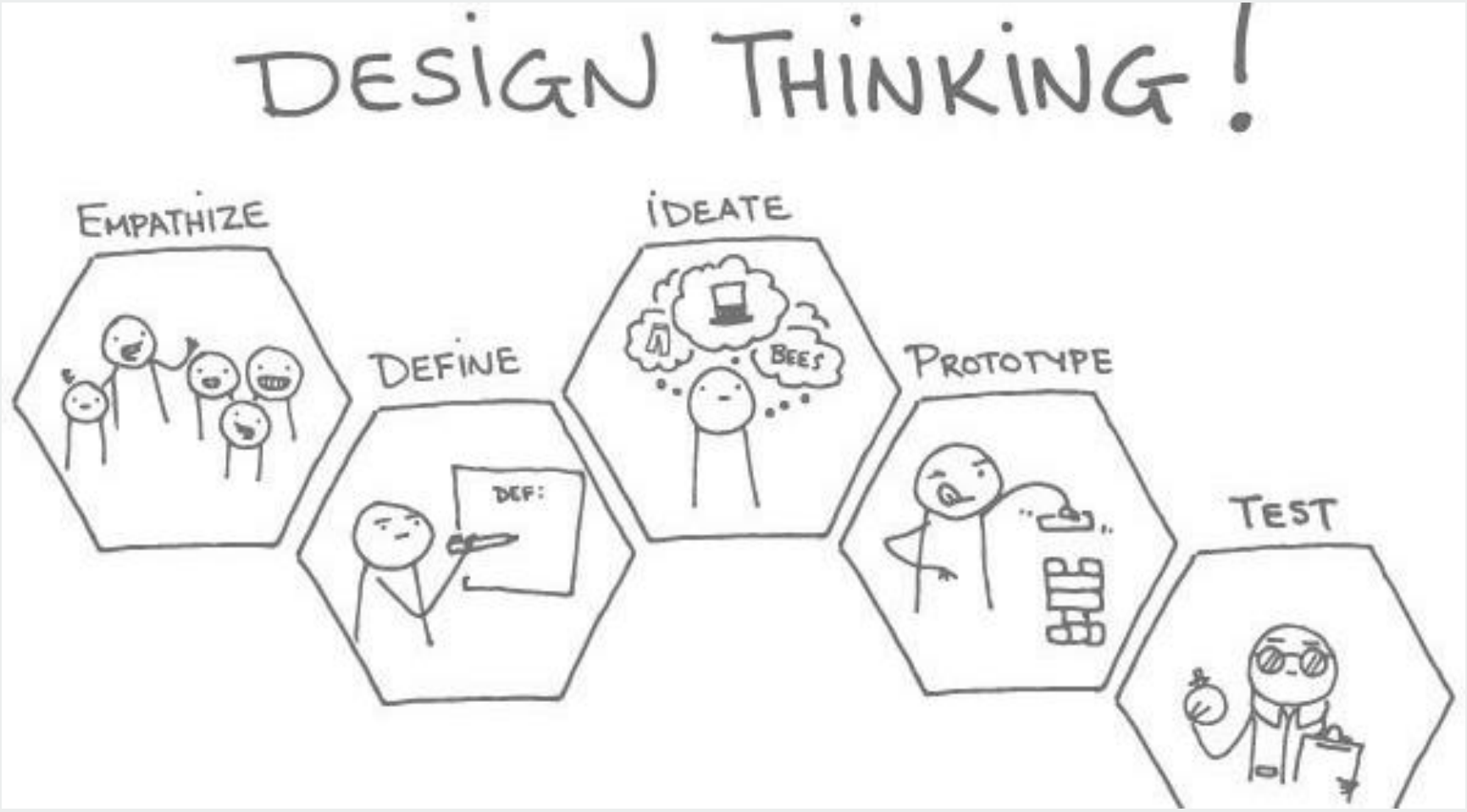
Objective

design the automation transition

- take over request
- hand over
- understanding of automation status

in a trustworthy way

Appendix


DESIGN THINKING!
EMPATHIZE
DEFINE
DEF:
IDEATE
BEES
PROTOTYPE
TEST

The mission: to create an user centered solution

1 Interview 5 min

Focus up

3 Catch 3 min

Goal: which is the most important objective for the user?

Insights: what have you discover about the motivations of your user?

2 Define 2 min

_____

(user name)

S/he needs a way to…:

_____

_____

(user need)

Why/but:

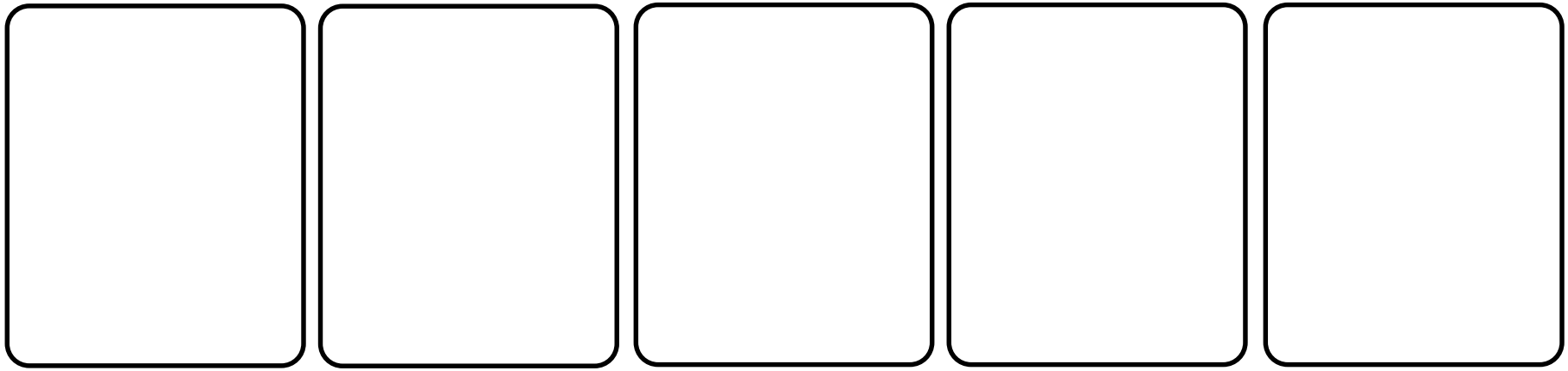
_____

_____

(intuition)

Create alternative solutions

5 Sketch at least 5 ideas that match the user needs 8 min



6 Share the solutions and keep the user feedbacks 7 min

Prototype and Test

7 Think and create a new solution 6 min

9 Share and reach the feedbacks 4 min

+ what is ok…

- What shoul be improved…

? Questions…

! Ideas…