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CarSketch: A Collaborative Sketching Table with Self-Propelled Tangible Objects for Automotive Applications

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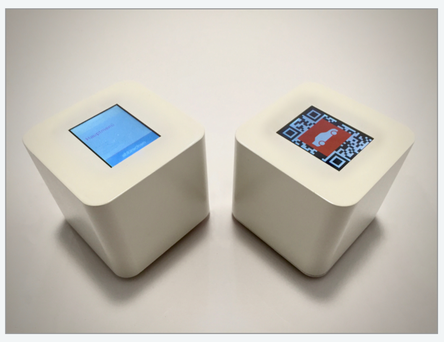
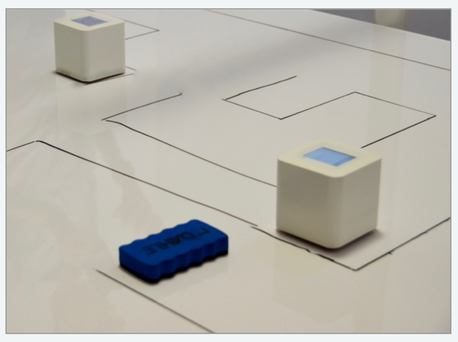
Abstract

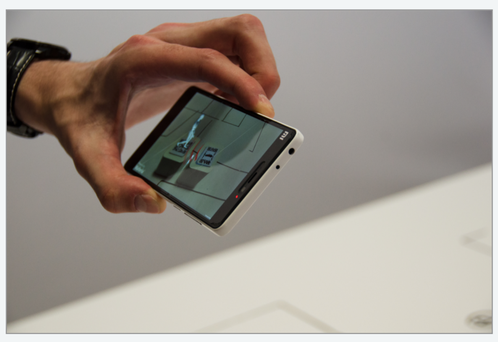
We present CarSketch, a concept and prototype of a collaborative sketching table that supports interdisciplinary development teams during the early development phase of driver assistance systems. Due to the high costs ΩÁ with the use of physical prototypes, simulation is a common approach. Yet, the operation of state-of-the-art simulations is restricted to specialists, leaving the majority of stakeholders as passive observers. Our system for a collaborative and multi-perspective communication tool enables all participants to interact with the simulation. In particular, it ***(1) structures the ideation and development by providing a distraction-free environment with an easy-to-use drawing interface, (2) which is used by self-propelled tangibles to monitor and influence the simulation. (3) Additional information is provided by personal augmentation and (4) the simulation can be replayed in an immersive 3D environment***. We expect the tool to be useful for multidisciplinary teams in fostering the ideation phase and detecting conceptual mistakes more efficiently.



Self-propelled tangible objects.



Ideation board during sketching.



Augmentation using a smartphone application.

Motivation

- Digital simulations are able to accelerate development by promoting understanding among collaborators involved [1, 2]
- Current simulation tools require expert knowledge or are too time-consuming, which is why users are falling back to the use of traditional tools like Powerpoint
- Due to spatial inflexibilities, tools might not be available where they are actually needed
- Developers consider creating presentations a time-consuming task that disrupts workflow.
- Developers have difficulty trying to explain technical issues to non tech-savvy coworkers
- Current tools are decoupled from the development process; reacting to short-term changes is difficult
- Current tools do not provide documentation of findings; Therefore, documentation is often neglected

Methodology

Our proposed system is the outcome of an iterative design process with weekly reviews. Initially, semi-structured interviews were conducted in order to identify issues within the current development workflows and communication process as well as for analysing currently available tools. This was supplemented by an on-site visit to a car manufacturer, where we conducted interviews with (1) experts at the R&D department and (2) a target group of potential users of the system. Based on the key findings, three concepts were elaborated, with the best being prototyped and further assessed by i) an expert group of engineers, HCI researchers & industrial designers, ii) board of directors of the R&D department and iii) a target group consisting of engineers, psychologists & managers.

Conclusion

We presented an early stage of a novel concept for a collaborative prototyping and presentation tool in the automotive field, which aims to support the ideation process and to promote team communication. **By providing access for all stakeholders in the early development stage, this work provides a significant improvement on the development process in the automotive industry.** The feedback gained from expert and target group interviews were positive throughout.

Future research

For future research, we will conduct a real-world evaluation of our system. Furthermore, we will evaluate appropriate metaphoric representations, in particular those for traffic signs and urban objects, aiming to develop a "symbol toolkit" that can be used during ideation. In addition, the feedback received suggested that it would be useful to have an interface to automate the conversion of proprietary data from the vehicle's control units to tangibles.

Our Concept

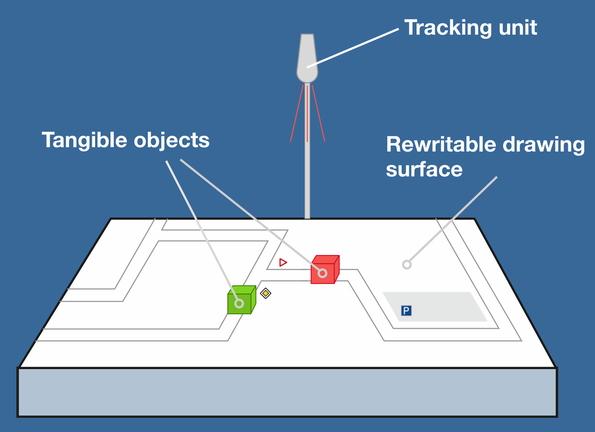
Ideation: Clearly structured, distraction-free creative multi-user workspace

Motion: Adding interactivity to supplement the development process

Augmentation: User-specific on-demand enrichment with additional information

Immersion: Multi-perspective virtual renderings based on the data-generated

Final Prototype



Rewritable drawing surface: Scenarios can be sketched using water-soluble pens and erased with rags. Hence, users are able to draw the scene by adding streets, intersections, and objects for traffic guidance, such as traffic signs or pedestrian crosswalks.

Self-propelled tangibles: Able to move independently according to drawn lines and objects, the tangibles represent different types of road users like cars, motorbikes, cyclists or pedestrians. Their settings can be modified using the embedded touchscreen.

Tracking unit: Centrally placed on one side of the ideation surface, it houses an 8-megapixel camera which is used to capture the sketches and the moving tangibles. The image data is processed using computer vision and is used to control the movements of the tangibles.

Features at a glance

- Multi-user support
- Intuitive user interface
- Embedded into the development process
- Controls information flow
- Portable design
- Multi-perspective simulation
- Documentation

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Credits: „Pen“ icon by andriwidodo, “Vr“ icon by mikicon, “Eye“ icon by il capitano, “motion“ by nick abrams from the nounproject.com.

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[1] Bart Broekman and Edwin Notenboom. 2003. Testing embedded software. Pearson Education

[2] Frank Flemisch, Julian Schindler, Johann Kelsch, Anna Schieben, and Daniel Damböck. 2008. Some bridging methods towards a balanced design of human-machine systems, applied to highly automated vehicles. (2008).

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