

The Tangible Car – Rapid Intuitive Traffic Scenario Generation in a Hybrid Table-top and Virtual Environment

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Wrong Assistance System Behavior - 1

- Ever driven a car with cruise control?
- Did you take the foot off the gas pedal?
- Did a slower car then pull on your lane?
- **You startled?**
- **You hectically moved you foot from somewhere to the brakes?**

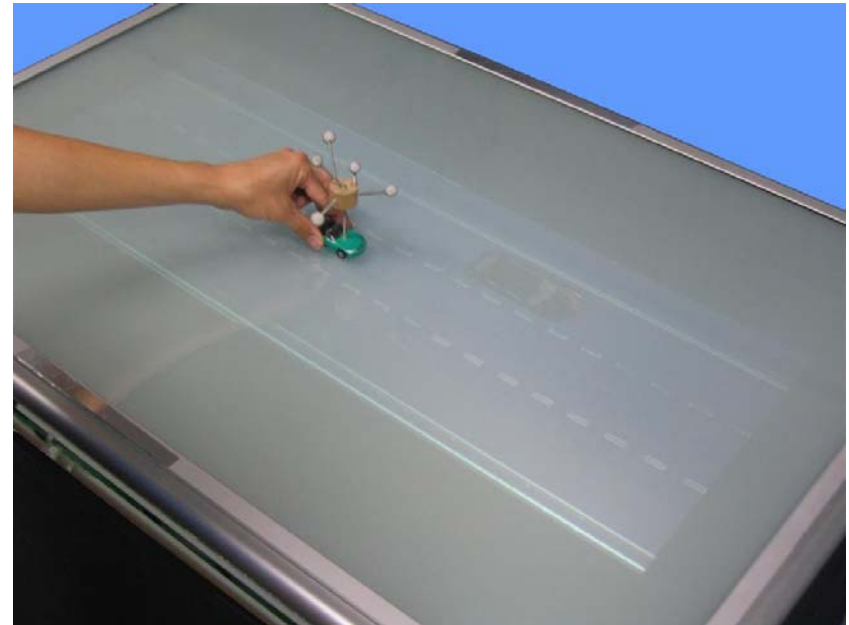
Wrong Assistance System Behavior - 2

- Ever driven a car with Adaptive Cruise Control (ACC)?
- Did you take the foot off the gas pedal?
- Did a slower car then pull on your lane?
- **Did the ACC turn off instead of braking?**
- You startled?
- You hectically moved your foot from somewhere to the brakes?

- What happened?
 - You were taken out of the loop
 - The assistance system showed a different behavior than the human driver

Traffic Scenario Development

- The delta between a assistance system's behavior and human behavior must be minimized
- Early testing of behavior in VE
- Problem: How to get realistic traffic scenarios?
- My Approach:
Tangible car on table-top



Overview

- Opportunities for Traffic Scenarios Development
- Concept: A Table-Top Tangible Car
- System Setup
- Issues of Development Workflow
- Conclusion and Future Work

Opportunities for Traffic Scenarios Development

Through real cars:

- With several cars
 - Not reproducible
 - Dangerous for participants
 - Subjective factors are difficult to vary
- Through Sensor data in VEs
 - Complex analysis of sensor data



Reflecting Guardrail



Multiple Reflections per Car

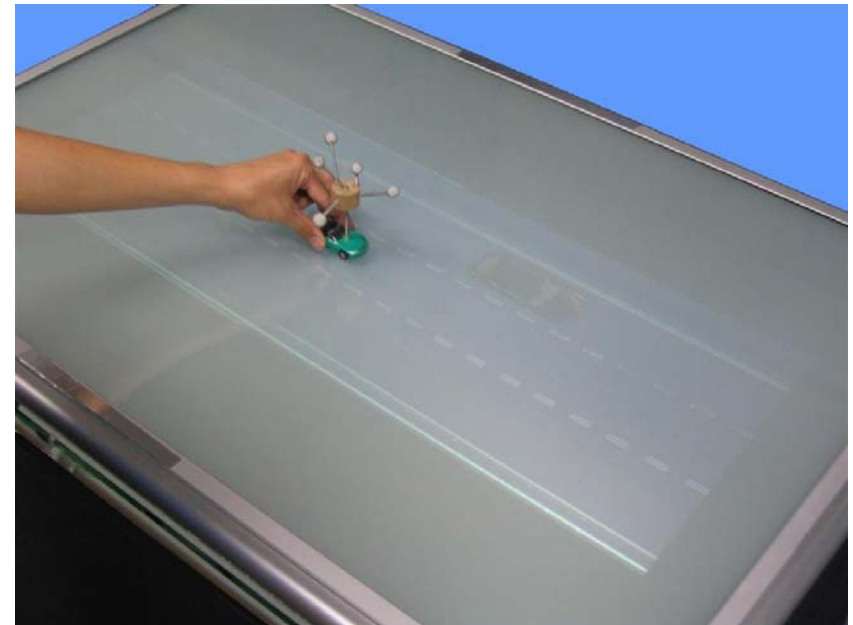
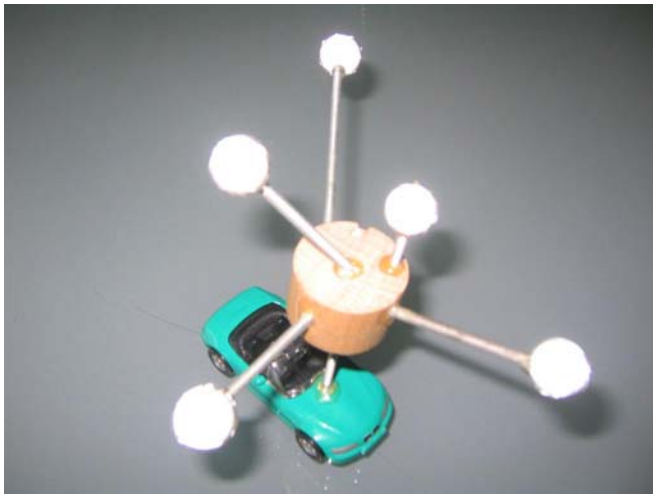
Opportunities for Traffic Scenarios Development

Through Simulation:

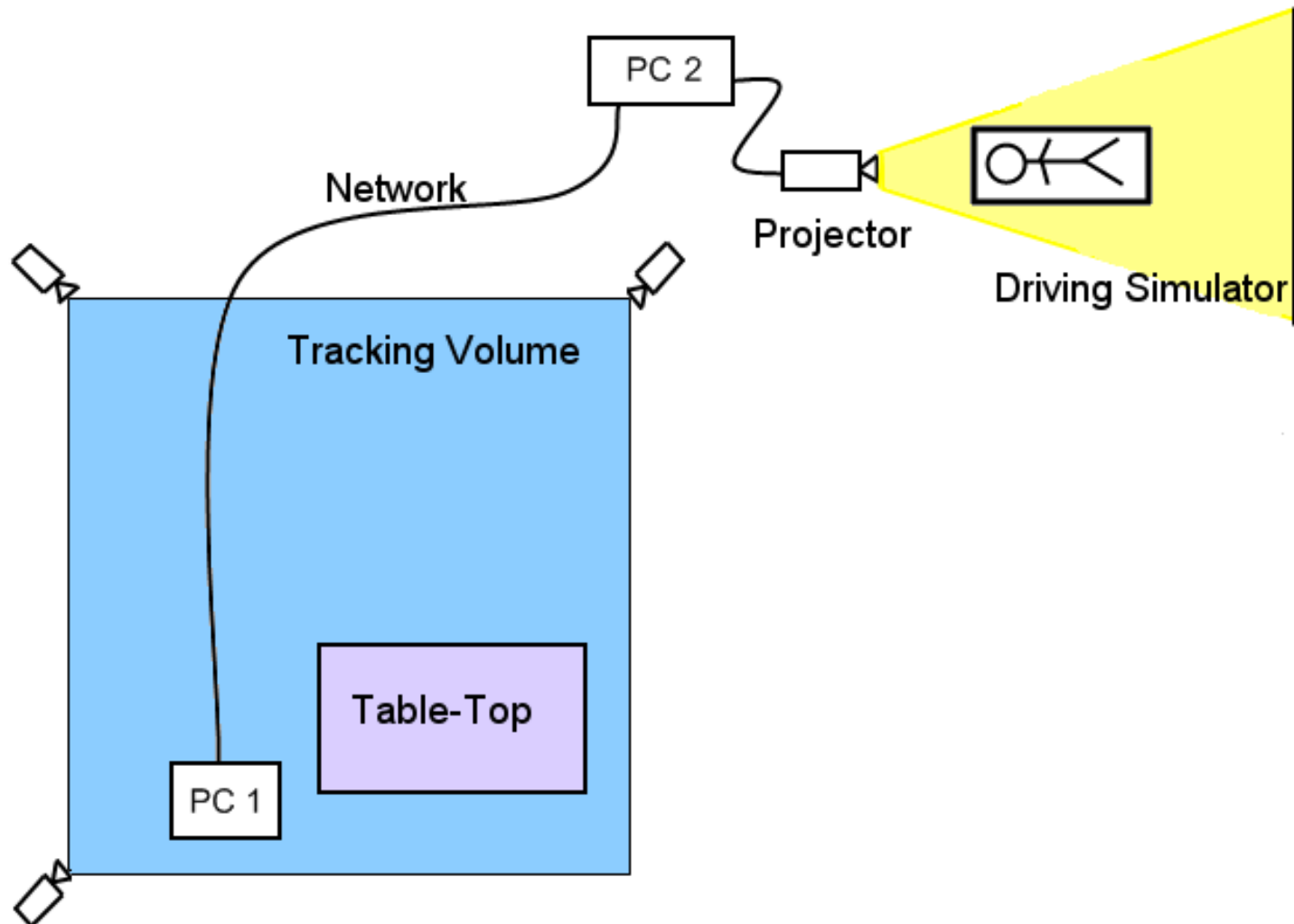
- Programmed control of foreign cars
 - Requires skills in programming
 - Variability of numerous factors
- Traffic simulation tools
 - Complex handling
 - Variability of numerous factors
- Discrepancy to reality
 - Evaluation only against a priori algorithms
 - Exact trajectories - no human noise
 - No atypical driving behavior

Concept: A Table-Top Tangible Car

- Test subject driven traffic scenario development
- Tangible car
 - Implicit metaphor: Moving (forward)
 - Secondary metaphor: Startling reflexes
 - Collaborative discussion



System Setup

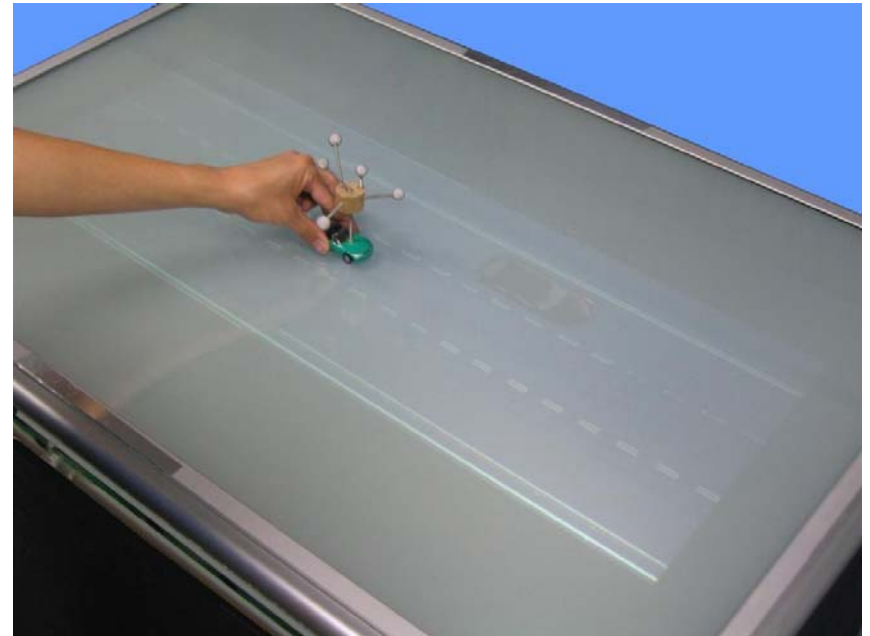


System Setup



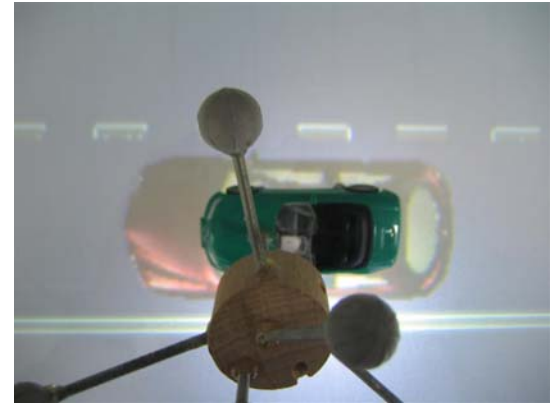
Issues of Development Workflow

- Non-disrupted independent scenario development procedure:
 - User / test subject can bring in own 3D models
 - User / test subject registers 3D model to tangible car
- Controlling the tangible car
- Limited table-top interaction space
- Iterative recording of car trajectories

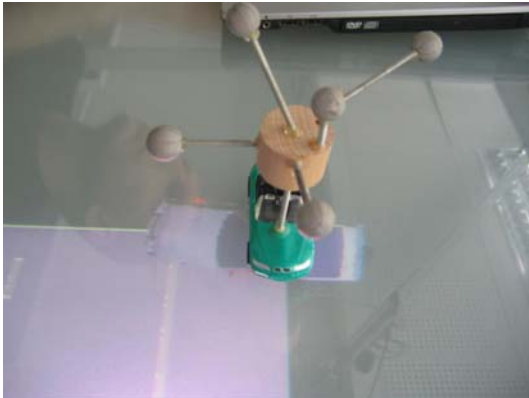


Object Calibration

- Scaling with graphical slider: 1.6 times the size



- Alignment



Limited table-top interaction space

Base speed applied to viewpoint and car



Please don't mind the jitter – rendering now is synchronized – but table was under reconstruction

Iterative recording of car trajectories



Please don't mind the jitter – rendering now is synchronized – but table was under reconstruction

Experiencing Traffic Scenarios



Please don't mind the jitter – rendering now is synchronized – but table was under reconstruction

Conclusion

- Rapid scenario development
 - Trained people
 - Highway scenario of one minute duration
 - including five cars
 - Excluding object calibration
 - About 8 minutes

- Future Work
 - Driving dynamics model
 - Additional visual stimuli (blinker signal)
 - Conduct full user study

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