Advancement and Prototyping of a Driver Interaction System for Simulated Test Drives

TECHNISCHE UNIVERSITÄT DARMSTADT

IIT BOMBAY

Advanced Design Project

Institute of Ergonomics TU Darmstadt

Industrial Design Centre IIT Bombay

Colloquium on 13.02.2017

Under the guidance of: Prof. Dr.-Ing. Ralph Bruder, Prof. Sugandh Malhotra

Supervisor: Lukas Bier

Source: American Association of Sleep Technologists Website https://www.aastweb.org/blog/what-to-expect-at-the-38th-aast-annual-meeting-drowsy-driving on 25-01-2017

Structure

TECHNISCHE UNIVERSITÄT DARMSTADT

- Introduction
- Scope of work
- Methods and procedure
- Interim results
- Conclusion and Future Scope of Work

Introduction

TECHNISCHE UNIVERSITÄT DARMSTADT

- During long driving in highways, monotony occurs very often, which lead to drowsiness and then to further accidents. *(Amini et al. 2016)*

- Based on studies it is assumed that around **21%** of all accidents are caused by drowsiness, for Germany it is **25%** and in the case of Indian Truck accidents, it is **57%**. Fatigue is one of the most dangerous causes for deadly accidents. *(Kusuma et al. 2016)*

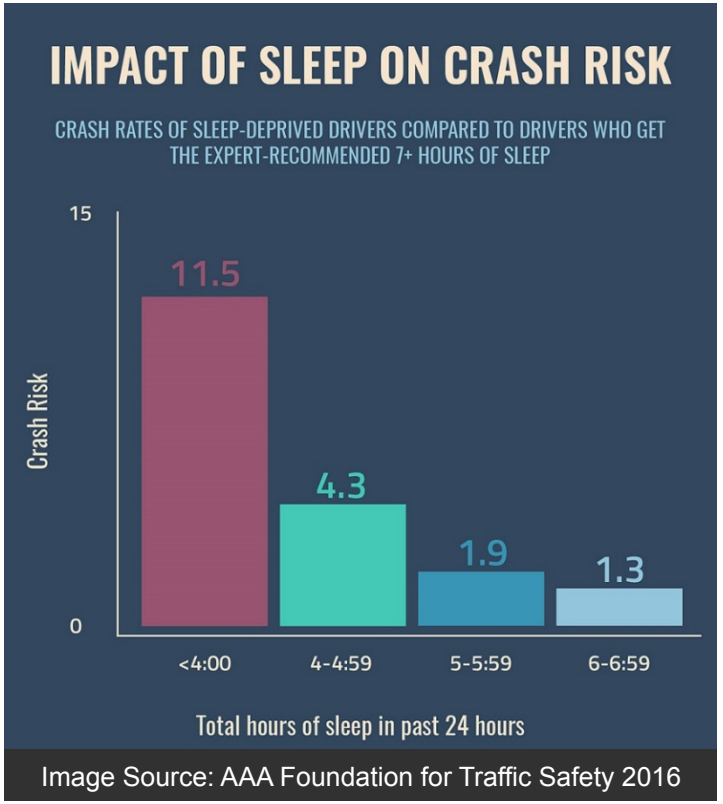


Image Source: AAA Foundation for Traffic Safety 2016

How to reduce Drowsiness

TECHNISCHE UNIVERSITÄT DARMSTADT

- There are is no specific way as it depends on different user condition and context. But as a whole we can develop a system which can counter most the reasons. Some of the possible ways are
  - Change of Driving Environment
  - Anxiety Information/Alarm Generation
  - Draw attention by new information
  - Change of the affective mood
  - Replacing the tiring activity by others tasks (preferably driving related) which will reduce monotony & also give a **Feeling of a Co-driver**

Amini et al., (2016).

Symptoms of Drowsiness

TECHNISCHE UNIVERSITÄT DARMSTADT

- Less than 6-7hrs. Sleep
- Yawning frequently
- Trouble to keep head up
- Difficulty for focusing *Hold the Speed Game*
- Frequent eye blinking with heavy eye-lid
- Unable to remember last few miles *Quiz related to driving*
- Miss exits and traffic signages *Hold the Distance Game*
- Drifting from lanes *Hold the Lane Game*

Amini et al., (2016).

Scope of work

TECHNISCHE UNIVERSITÄT DARMSTADT

- Gamification
  - What?

    Use of game design elements in non game context
  - Why?

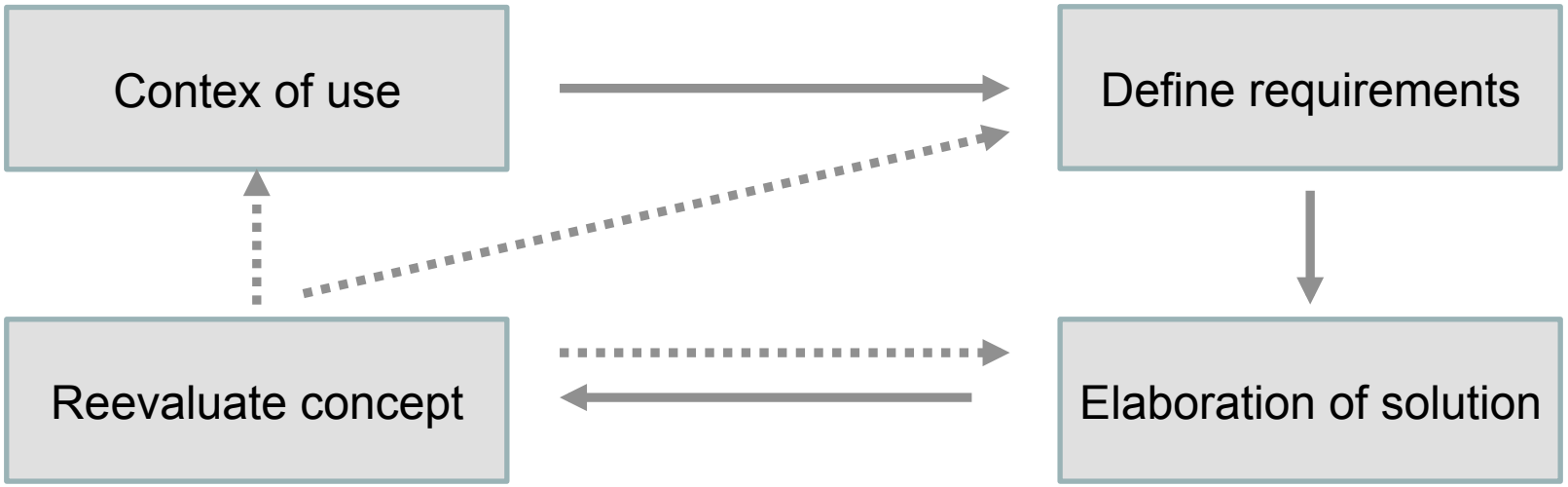
    Enhance intrinsic motivation
  - How?

    Virtual co-passenger assisting you while driving

- Wizard of Oz
  - Driver in driving simulator interacts with an “autonomous” assisting system → “wizard” hides behind HCI

Schroeter et al., (2014)
Deterding et al., (2011)

Human centred design process



Amini et al., (2016).

Context of use for the driver

TECHNISCHE UNIVERSITÄT DARMSTADT

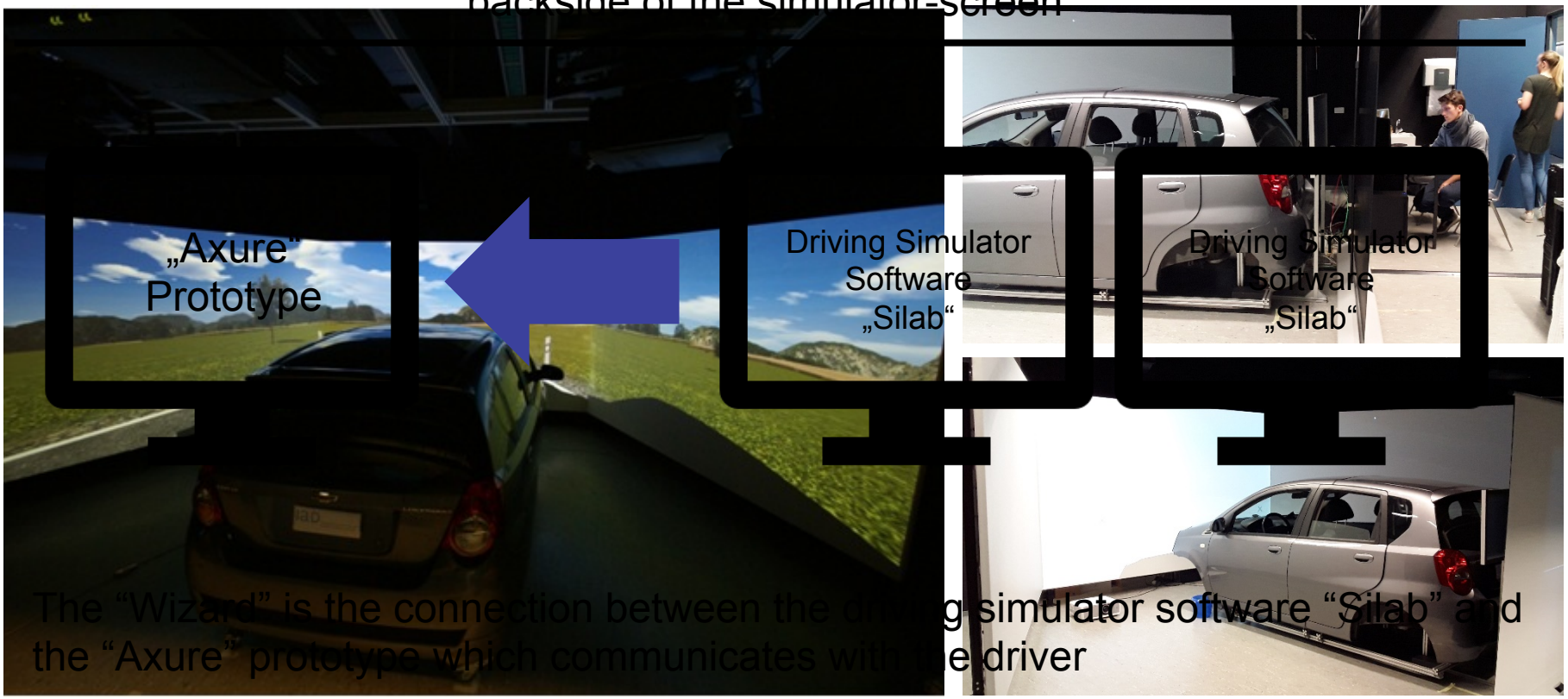
Head-up Display

LCD Display Touchscreen?

Audio System

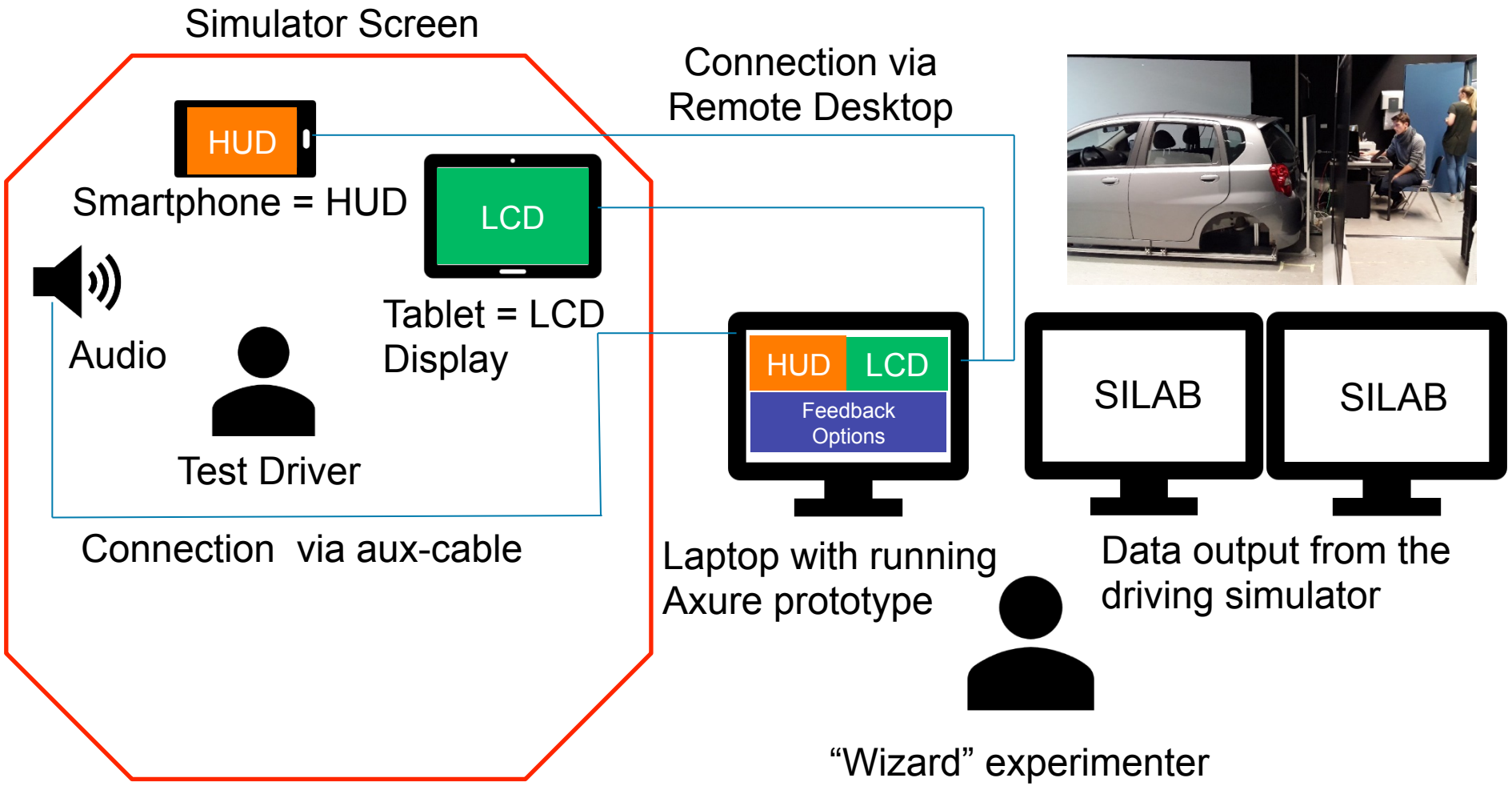
Amini et al., (2016).

Context of use for the “Wizard”-experimentator



Driving Simualtor on the webside of the IAD, retrieved on 25.01.2017 from http://www.iad.tu-darmstadt.de/forschung_15/methodenundlabore/fahrsimulator.de.jsp

Prototype concept

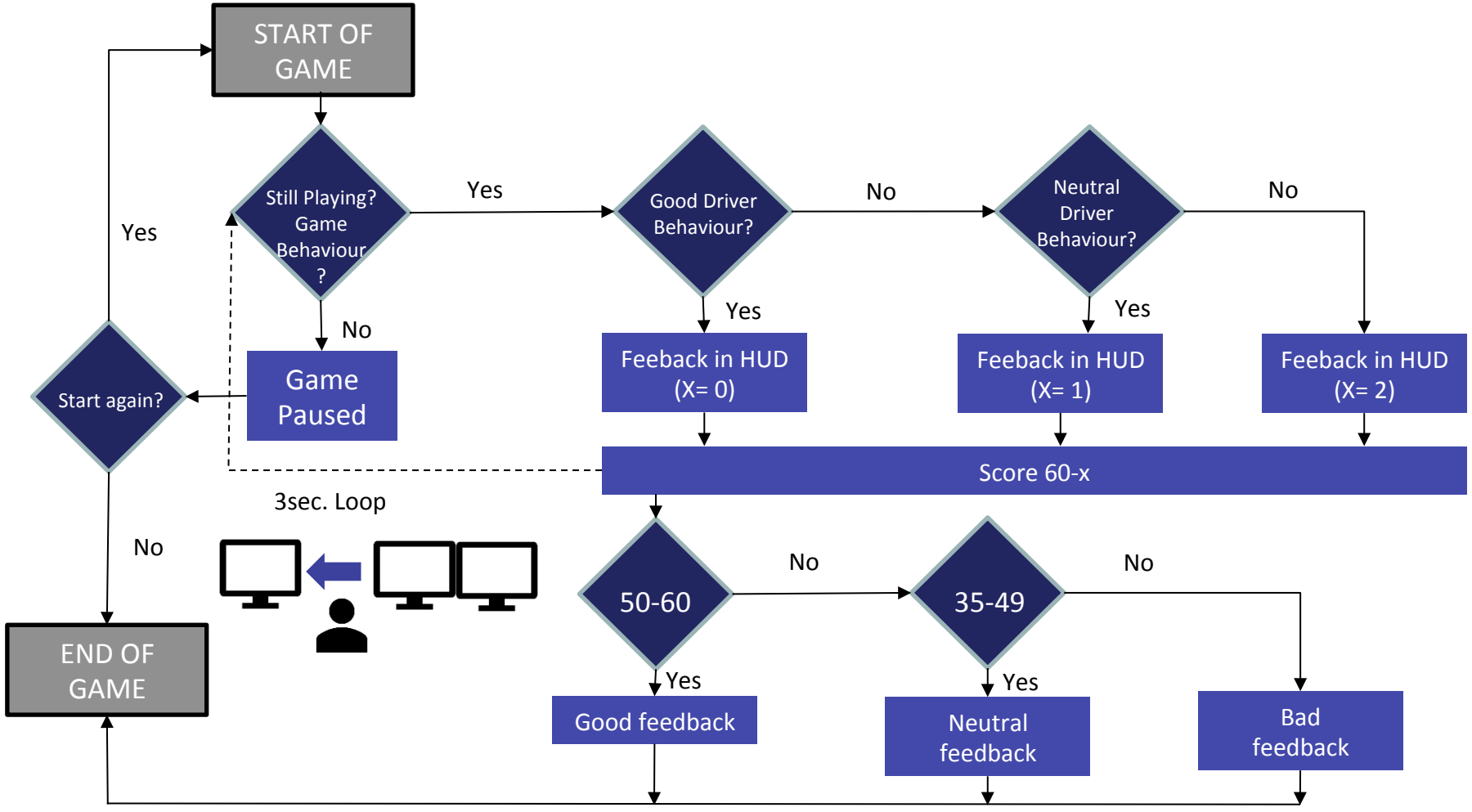


Features of the prototype

TECHNISCHE UNIVERSITÄT DARMSTADT

- Up to now three driving games were integrated into the prototype
  - Holding Speed
  - Holding Lane
  - Holding distantce to the car ahead
- Time period of 60 seconds for every game
- Preparation before starting the virtual co-driver
  - Cruise control and assistant systems to hold distance to the car ahead or holding the lane must be turned off
  - Driver gets audio instructions about the challenge

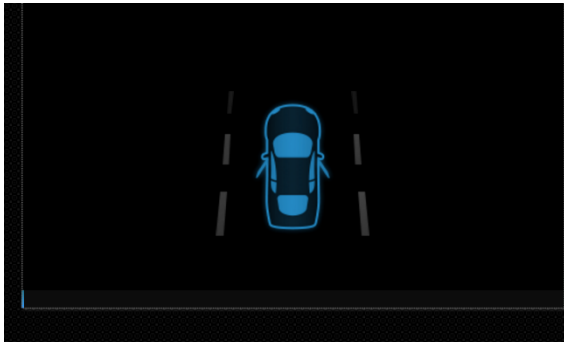
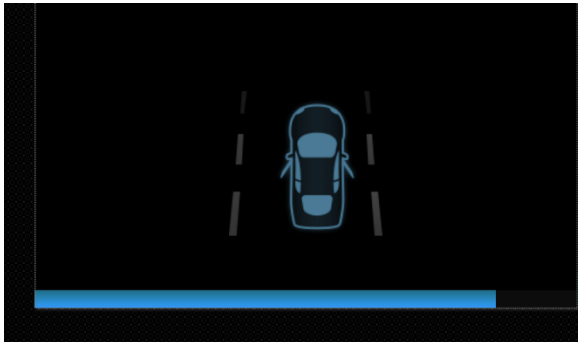
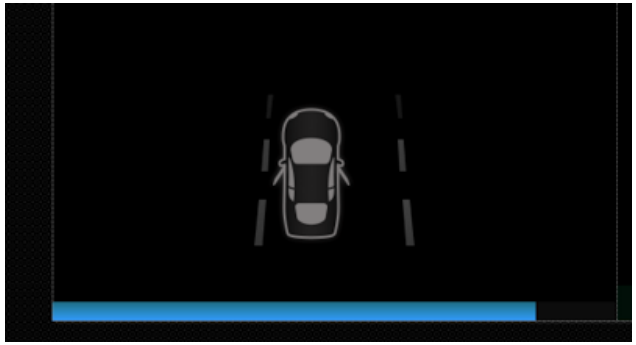
Features – Flowchart for scoring system



Features – feedback

TECHNISCHE UNIVERSITÄT DARMSTADT

- Visual feedback during the game at the HUD
  - Current position/ behaviour and duration of the game
  - Without a visual feedback the monotony returns after a short time of playing

- Audio and visible feedback after finishing a game, depending on the score (in the demo)

Demonstration of the prototype

TECHNISCHE UNIVERSITÄT DARMSTADT

Click to open prototype

Conclusion and outlook

TECHNISCHE UNIVERSITÄT DARMSTADT

- Conclusion
  - Driving games implemented into prototype
  - Concept is developed
- Outlook, especially for out work in India
  - Improving controllability
  - Adding quiz features
  - First round of evaluation and iteration
- Future scope of work after ADP is finished
  - Physical product (Master thesis of Anirban)
  - WOZ experiments will be performed at IAD

Sources

TECHNISCHE UNIVERSITÄT DARMSTADT

- Source: American Association of Sleep Technologists Website: https://www.aastweb.org/blog/what-to-expect-at-the-38th-aast-annual-meeting-drowsy-driving on 25-01-2017
- Kusuma et al., (2016). *Review on Drowsy Driving: Becoming Dangerous Problem* at International Journal of Science and Research (IJSR) ISSN (Online): 2319-7064
- Amini et al., (2016). *Concept Design of an HMI to Lower Monotony Caused Reduction of Driving Performance.* ADP at TU Darmstadt, Institute of ergonomics
- Schroeter et al., (2014). *AR and Gamification Concepts to Reduce Driver Boredom and Risk Taking Behaviours*
- *Deterding et al., (2011). From Game Design Elements to Gamefulness: Defining "Gamification"*

TECHNISCHE UNIVERSITÄT DARMSTADT

Thank you for your attention!

Requirements I

TECHNISCHE UNIVERSITÄT DARMSTADT

> Orientation at ISO 9241-110 (dialogue principles)

Principle	Requirements for the prototype of virtual co-driver	Requirements for the Wizard interface
Suitability for the task	No excessive occupational and cognitive demand	Conduct experiments easily using a graphic user interface
Suitability for individualisation	German and English language	
Suitability for learning		Explanation, when courser stays on a button.

Requirements II

TECHNISCHE UNIVERSITÄT DARMSTADT

Principle	Requirements for the prototype of virtual co-driver	Requirements for the Wizard interface
Conformity with user expectations	Break monotony, long-term effect	Investigation of the impact of the virtual co-driver without physical interaction between wizard and test driver
Self descriptiveness	Icons and visible feedback must be self-describing	
Controllability	Start and finish always possible	Every scenario must be controllable
Tolerance of error	User can always skip back in the menu	

Features - Game Rules

TECHNISCHE UNIVERSITÄT DARMSTADT

	Conditions	Good feedback	Neutral feedback	Bad feedback	Interruption	Resume
Lane	Monotonous conditions + car on the same lane for atleast 60 seconds	Ideal position: 15 cms from the middle of the lane	neutral if between 15 to 25 cms	Bad if more than 25 cms and still within the lane	When the driver changes lane	Comes back to the lane and after 60 seconds
Speed	Cruise control is off + monotonous conditions satisfied. 0 to 5% difference is ideal range	Based on feedback collected at a 3 second frequency, an average change of between 0 to 2% is considered good	2% to 5% is considered netural and more than	5% is considered bad	Speed variance more than 5%	After 60 seconds of maintaining a new range of speed
Distance	Ideal distance from the vehicle in front is half the speed (km/hr) of the car in metres	Actual distance is between 100% to 110 % of ideal distance	Actual distance is greater than 110% of ideal distance	Actual distance is between 90% to 100% of ideal distance	Lane change	On demand