Designing for Enhancing Situational Awareness of Semi-Autonomous Driving Vehicles

Figure 1 The prototype platform: a semi-autonomous driving vehicle.

Figure 2 d-SPACE was implemented in the back of car.

Chao Wang
Eindhoven University of Technology
Eindhoven, the Netherlands
wallacewangchao@gmail.com

Sander Steeghs
Debayan Chakraborty
Archita Gorle
Debargha Dey
Eindhoven University of Technology
Eindhoven, the Netherlands
sander.steeghs@student.fontys.nl
d.chakraborty@student.tue.nl
a.gorle@student.tue.nl
D.Dey@tue.nl

Sietze van de Star
Adityen Sudhakaran
Eindhoven University of Technology
Eindhoven, the Netherlands
sietzevandestar@gmail.com;
adityen8@gmail.com

Jacques Terken
Jun Hu
Eindhoven University of Technology
Eindhoven, the Netherlands
J.M.B.Terken@tue.nl
J.Hu@tue.nl

AutomotiveUI '17 Adjunct, September 24–27, 2017, Oldenburg, Germany

ACM ISBN 978-1-4503-5151-5/17/09…$15.00
https://doi.org/10.1145/3131726.3132061

Abstract

Autonomous driving technology is evolving quickly, and self-driving cars are fast becoming a reality. In the level 2 autonomous driving stage, the system will take full control of the vehicle. The driver must monitor the driving and be prepared to immediately intervene at any time if the automated system fails to respond properly. As a result, the vehicle must be able to share its interpretation of the situation with the driver. In previous research, ambient light was used to delivering driving information. However, most of the studies were conducted on driving simulators. We designed a screen based interface combined with ambient light, which was implemented into a semi-autonomous driving vehicle. Based on this high-fidelity prototype, systematic tests can be conducted for verifying the usability of enhancing drivers' situational awareness by ambient light.

Author Keywords

Autonomous driving; situational awareness; ambient light.

Figure 3 Screen based interface.

Figure 4 The structure of the light:

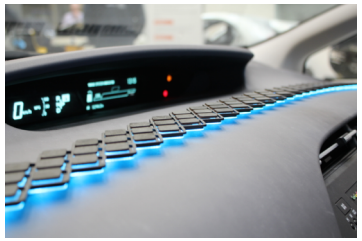

Figure 5 The ambient light on the dashboard.

CCS Concepts
• Human-centered computing~User interface toolkits

Autonomous-driving platform

The autonomous-driving platform is based on a Toyota Prius which is developed by *ATEAM* [1] of Eindhoven University of Technology and supported by *NXP*[2] (Fig. 1). Equipped with radar, a front camera and a data processing center (*d-SPACE,* which provided by NXP), it has the capability of Level 2 autonomous driving (Fig.2).

Screen based interface

An interface, which shows ego car's position, front cars position, the curvature of the road and the driving mode etc., was designed and implemented in an 8-inch screen. This interface explicitly delivers the information that sensors collected to the driver (Fig.3).

Ambient light

Ambient light was implemented on the dashboard. The light panel consists of three layers: 1) the LED layer, a LED strip which connects to an *Arduino*, receives data from *Raspberry PI*. 2) the frame layer, which consists of a piece of laser-cut Perspex as structure. 3) the cover layer, which are consists of 78 small pieces of components made of Perspex and wood to diffuse the light of LEDs (Fig.4).

Covered by the panel, the ambient light delivers the information to the driver in a peripheral way instead of disturbing him; Moreover, light is not reflected to the windshield. When the vehicle is in autonomous driving mode, the lights turn blue and the brightness changes from low to high repeatedly. If there is a car in front, the corresponding part of lights turn into white to indicate that the vehicle can "see" the vehicle (Fig.5,6).

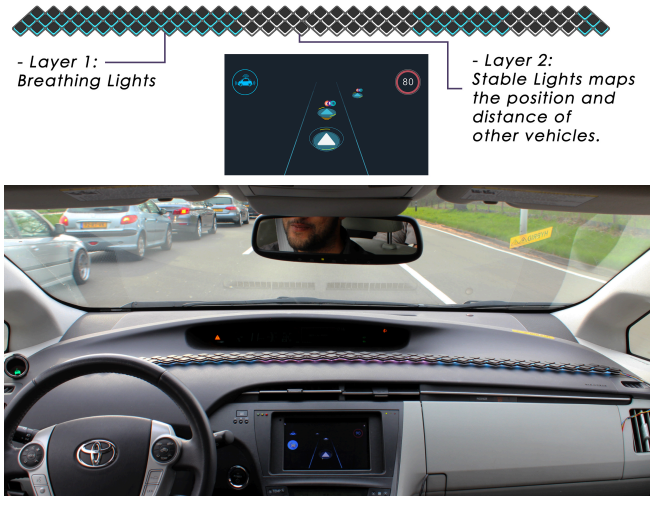

Figure 1: The synchronization of the interface and ambient light.

Demonstration requirement

An ambient light component and a screen with Raspberry PI with the interface could be shown in the conference, together with the video played on a Laptop. Furthermore, the autonomous-driving platform would be driven from the Netherlands to Oldenburg. It could be demonstrated statically outside the OFFIS building: only the ambient light and screen display pre-set information; or a dynamic demonstration could be conducted: the vehicle could be driven around OFFIS, and real-time information could be shown in the HMI.

[1] http://ateam-eindhoven.nl

[2] http://www.nxp.com