Non-Conventional Traffic Participants for Semi-Autonomous Vehicles

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**RESEARCH**

Undertake research in Intelligent User Interface Design

PhD students funded by Harman (a Samsung company), Bosch and CSIR- National Aerospace Laboratories

Four ACM Doctoral Consortium selections with full travel support (AutoUI 2017, UMAP 2018, AutoUI 2019, IUI 2020), filed 5 patents including 4 PCT applications

Worked with Jaguar Land Rover, Technicolor, BAE Systems from 2010 – 16

Principal Investigator of projects funded by Microsoft, Facebook, BT, Wipro, Faurecia, DST, and DRDO

AI for Accessibility Grant Award from Microsoft and Early Career and DUO Fellowship (with University of Barcelona) Award from DST

**MEDIA COVERAGE**

[Images of media coverage related to AI and accessibility]
Contents

- Context
- Accuracy and Latency of existing systems for non-conventional traffic participants
- Novel HCI for Autonomous Vehicles
- Synthetic Dataset using VR
- Conclusion
## Autonomous Vehicles

<table>
<thead>
<tr>
<th>Level</th>
<th>Features</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level 0</td>
<td>no automation</td>
</tr>
<tr>
<td>Level 1</td>
<td>Features include lane keeping assist, adaptive cruise control, emergency brake</td>
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<tr>
<td>Level 2</td>
<td>Autonomous technology can simultaneously control longitude and lateral movement at same time</td>
</tr>
<tr>
<td>Level 3</td>
<td>Equipped with full autonomous technology, but shift control back to driver if they are unable to perform</td>
</tr>
<tr>
<td>Level 4</td>
<td>Fully autonomous without human intervention. If system fail, vehicle automatically stop</td>
</tr>
<tr>
<td>Level 5</td>
<td>full driving automation</td>
</tr>
</tbody>
</table>
HCI example in Connected Vehicle

Two cars, one driver: New Skoda tech to make autonomous car follow a manned one

Skoda Auto's latest autonomous driving technology is currently being tested on two correspondingly configured Skoda Superb IVs.

The technology aims to have autonomous cars follow a manned lead vehicle using essential data transmitted through radio.

In another step towards autonomous driving, Skoda Auto has partnered with VSB - Technical University of Ostrava, Czech Republic, to develop new technologies for driving assistance systems.

The collaboration between the two parties involve a 'Follow the Vehicle' project that aims to have autonomous cars follow a manned lead vehicle. The technology, currently being tested on two correspondingly configured Skoda Superb IVs, has potential for car-sharing service providers, car rental companies or fleet operators.

The 'Follow the Vehicle' project follows the principle of 'two cars, one driver' where the lead vehicle is driven by a human, determining route, speed, lane and other parameters. The autonomous car follows the lead vehicle at a distance of up to ten metres. Data regarding steering input, acceleration and braking is transmitted to the self-driving car through radio.

AUTONOMOUS VEHICLE PROJECTS

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I^3D LAB

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Centre for Product Design and Manufacturing
Robert Bosch Centre for Cyber Physical Systems
Co-Chair, IRG AVA, International Telecommunication Union
Member, UKRI International Development Peer Review College
Training Model for Object Detection
Classical Computer Vision Pipeline

1. Select / develop features: SURF, HoG, SIFT, RIFT, ...
2. Add on top of this Machine Learning for multi-class recognition and train classifier

Classical CV feature definition is domain-specific and time-consuming
Convolutional Neural Network (CNN)

- Fully Connected Feedforward network
- Convolution
- Max Pooling
- Can repeat many times

Image Source: internet

Cats are not easy to catch
Synthetic Data Set Preparation

GENERATIVE ADVERSIAL NETWORK

- Two competing Neural Net
- Deconvolution + Convolution
- Controlled noise addition
- Numerous applications in image processing, face recognition

VR DIGITAL TWIN

- Setting up a full mock up
- Customized data set
- Complete control of context
  - Ambient light
  - Camera angle
  - Bystanders
- Validated with real video

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Auto-Encoding Variational Bayes

Example of Directed Generative Nets on Frey faces

Model learned two independent factors of variation

X-axis shows rotation

Y-axis shows emotion
The ParallelEye Dataset

Fig. 2. Basic framework and architecture for parallel vision [23].


Prospective Research Problems

- HCI in Autonomous Vehicle
- Alternative Modalities of Interaction
  - AR/VR systems
  - Novel input modalities
- Terrestrial vs Aerial Vehicles
- Cognitive load of Drivers