Non-Conventional Traffic Participants for Semi-Autonomous Vehicles

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I³D Lab (2016-present) https://cambum.net/I3D.htm

RESEARCH

Undertake research in Intelligent User Interface Design

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

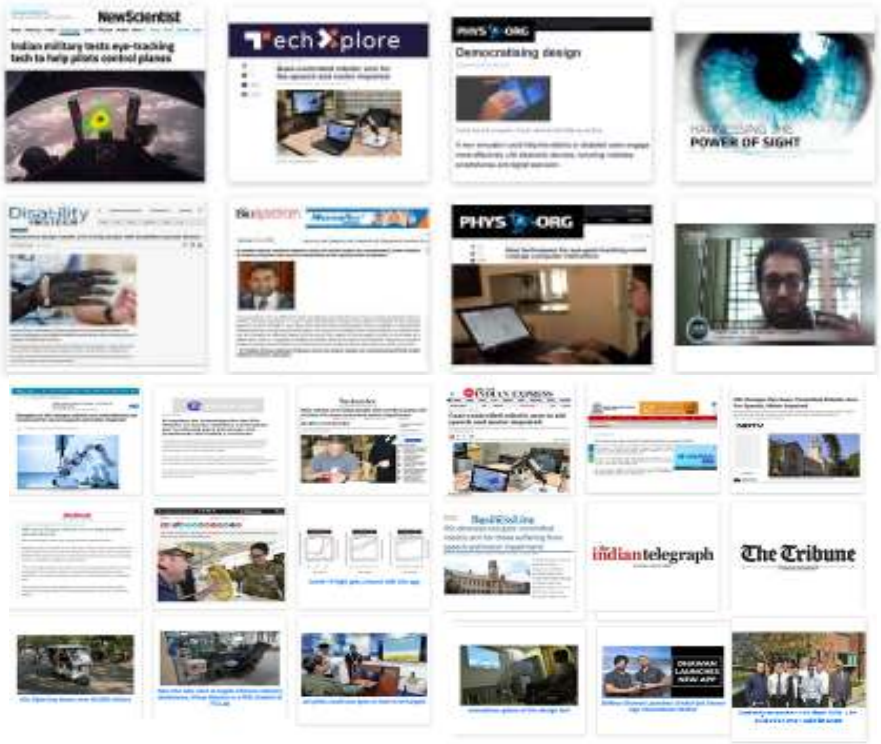
Four ACM Doctoral Consortium selections with full travel support (AutoUI 2017, UMAP 2018, AutoUI 2019, IUI 2020), filed 5 patents including 4 PCT applications

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



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

level 0	**no automation**
level 1	Features include lane keeping assist, adaptive cruise control, emergency brake
level 2	Autonomous technology can simultaneously control longitude and lateral movement at same time
level 3	Equipped with full autonomous technology, but shift control back to driver if they are unable to perform
level 4	Fully autonomous without human intervention. If system fail, vehicle automatically stop
level 5	full driving automation

HCI example in Connected Vehicle

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

1 min read . 22 Nov 2020

HT Auto Desk . Edited By Deepika Agrawal

- 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.

https://auto.hindustantimes.com/auto/news/two-cars-one-driver-new-skoda-tech-to-make-autonomous-car-follow-a-manned-one/amp-41606046295535.html

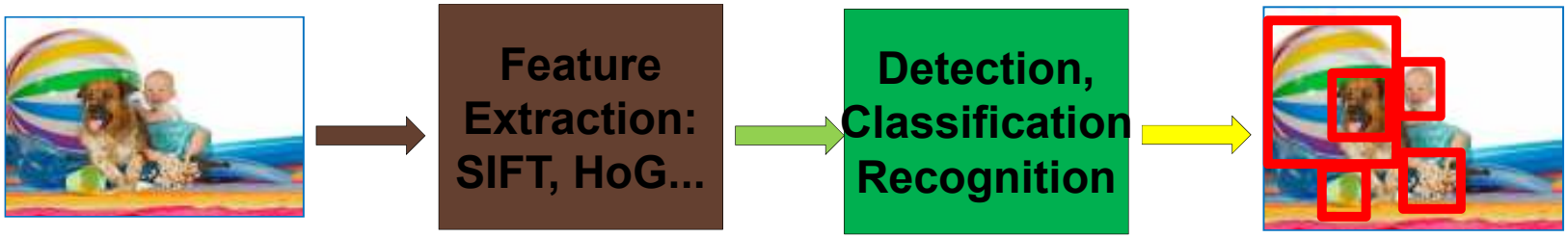
AUTONOMOUS VEHICLE PROJECTS @ I³D LAB

Pradipta Biswas, PhD (University of Cambridge Computer Laboratory & Trinity College, UK)
Assistant Professor, Indian Institute of Science
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

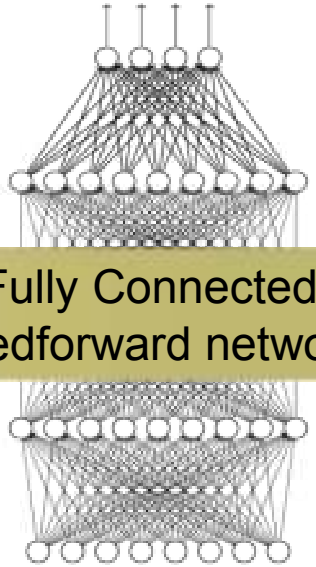


Classical CV feature definition is domain-specific and time-consuming

Convolutional Neural Network (CNN)

Cats are not easy to catch

cat dog ……



Fully Connected Feedforward network

Convolution

Max Pooling

Convolution

Max Pooling

Can repeat many times

Flattened

Image Source: internet

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

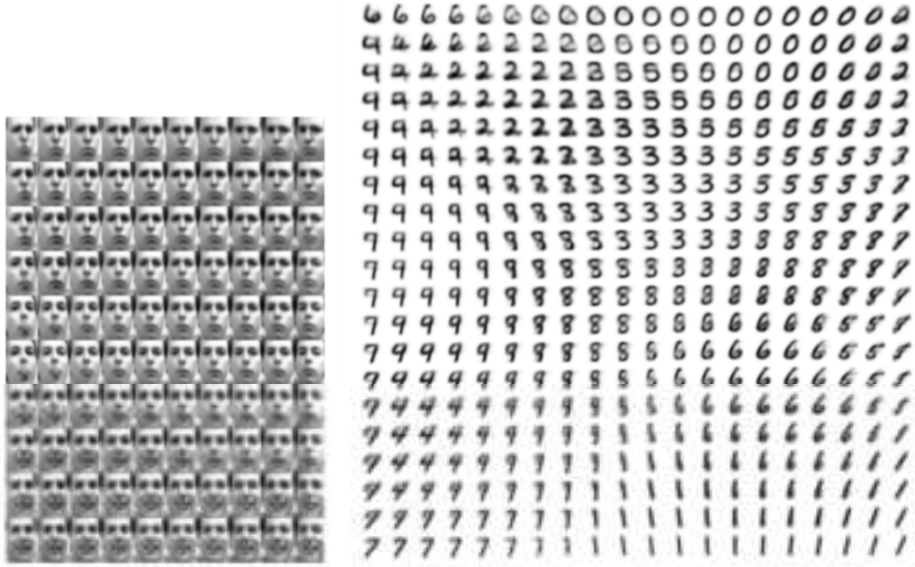
Customized data set

Complete control of context

- Ambient light
- Camera angle
- Bystanders

Validated with real video

Auto-Encoding Variational Bayes



(a) Learned Frey Face manifold (b) Learned MNIST manifold

Figure 4: Visualisations of learned data manifold for generative models with two-dimensional latent space, learned with AEVB. Since the prior of the latent space is Gaussian, linearly spaced coordinates on the unit square were transformed through the inverse CDF of the Gaussian to produce values of the latent variables $\mathbf{z}$. For each of these values $\mathbf{z}$, we plotted the corresponding generative $p_\theta(\mathbf{x}|\mathbf{z})$ with the learned parameters $\boldsymbol{\theta}$.

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

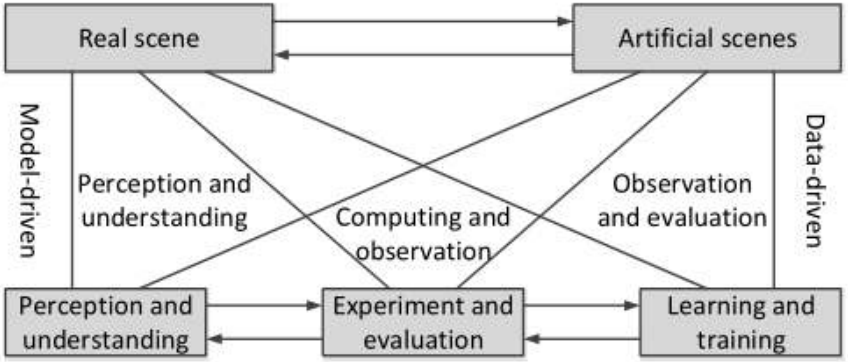
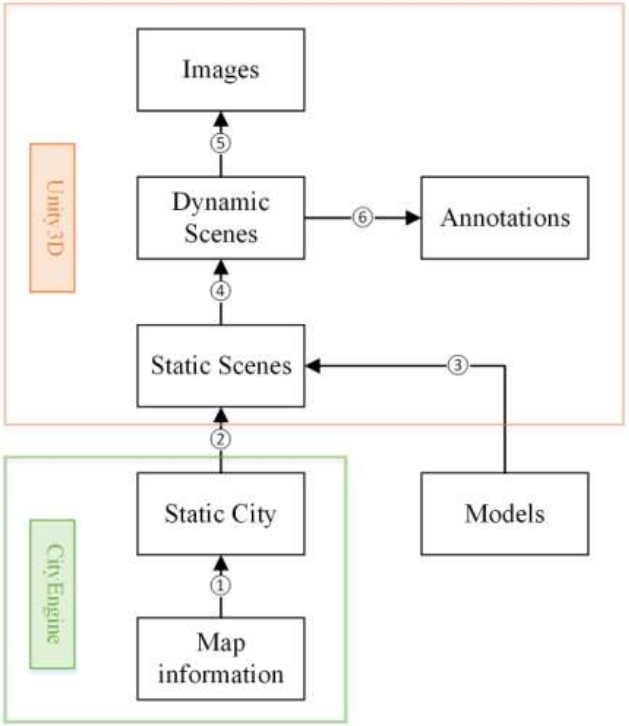


Fig. 2. Basic framework and architecture for parallel vision [23].



Li, Xuan, et al. "The ParallelEye dataset: A large collection of virtual images for traffic vision research." IEEE Transactions on Intelligent Transportation Systems 20.6 (2018): 2072-2084.

Židek, Kamil, et al. "An automated training of deep learning networks by 3D virtual models for object recognition." Symmetry 11.4 (2019): 496.


Center
Global
Account
Layers
Layout
Game
Display 1
Full HD (1920x1080)
Scale
0.817x
Maximize On Play
Mute Audio
Stats
Gizmos
Auto Generate Lighting On

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

Intelligent Inclusive Interaction Design

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faurecia Microsoft wipro DRDO ASHOK LEYLAND StanceBeam