A Quest for Human Robot Cohabitation

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Connecting AI Technologies to Real-World Needs Panel

Fujitsu World Tour 2017
Fujitsu North America Technology Forum 2017
Safe, Stress-free, Efficient, Enjoyable Driving

Understanding human behavior is essential for humans. It may very well be essential for robotic vehicles as well. Make humans and vehicles form a distributed cognitive system to accomplish mutually beneficial goals.

How to make two intelligent systems, one robotic and another human understand each other and collaborate?

Learning by Li Lo: Looking-in and Looking-out

Key Points: Humanizing Automated Vehicles

- “Driving” = Environment + Vehicle + Driver
- Autonomous Driving in the “Real World” ⇒ Humanized Robotic Systems
- Should be Proactive: highly reliable, safety-time critical operation

- Situational Awareness and Intent Predication – needs Holistic Perception
- Holistic Perception:
  - Looking-Out: Lanes, Vehicles, Pedestrians and “Surround”
  - Looking-In: Occupant and “Driver”
  - Looking In and Out: Attention, Intentions, Activities, “Awareness”

- Key Challenges:
  - Multilevel Signal-> Semantics Representation and Analysis
  - Multisensory and Distributed Systems and Software
  - Communication – speed, reliability, fail safe
  - Human-Centric (Distributed) System Architectures
  - Robustness
  - Performance and Evaluation Metrics, Protocols, Standards
"Humanizing" Intelligent Vehicles: LISA Research Agenda

- Distracted driver?
- Ready to take over?
- Hands on wheel?
- Safe to deploy airbag?
- Noticed pedestrian?
- Pedestrian intent?
- Pedestrian trajectory?
- My neighbor's intent?
- Distracted neighbor?
- Acknowledge right of way?


Vision for Intelligent Vehicles: LISA-A Test bed 2013

Gps unit
- Vehicle Dynamics Sensors
- Lane Solver
- Range Sensors
- MVI camera
- Lane Camera
- Vehicle Dynamics Sensors

Prof Trivedi, UCSD Fujitsu World Tour 2017
Looking In and Out: Lane Change Intent Prediction
[Discovery Channel, 2013]
Doshi, Morris, Trivedi, IEEE Pervasive Computing 2011

Aim: The early detection of an intended maneuver using driver, vehicle, and surround information.

Predictive Driver Assistance

• When should the driver merge?
• Should he accelerate or decelerate? How much?
• Is it ok to change lanes? If yes Left/right? If so, how?
• Can an “Intelligent” system assist with this?
Intelligent Merge- Break Assist, Attention Monitoring
CES Week, San Francisco Media Event, Jan 2014

Robust, Reliable, Generalizable, Practical,
Market ready in 2017!

Vehicle Trajectory Learning Flowchart


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Panoramic Trajectory Analysis

Looking at Humans in Surrounding Vehicles

Surround Vehicle Behavior Analysis

Intent prediction
Proposed Approach – Integration of Regions
Looking at Humans Around the Vehicle:
Pedestrian body pose and fine-grained classification
Pedestrian path prediction

Walking
?
Stopping


Looking at Humans Around the Vehicle: Detections

Proposed Approach – Integration of Regions
Looking at Humans inside the Vehicle

Privacy and Safety: Balancing the Scale

LISA SafeShield @ CES 2016


Holistic Distributed Cognitive Systems Perspective: Learning from Naturalistic Driving Studies, Predictive, Attentive Systems

Four Point Summary

Big Picture:
Safe, Stress-free, Efficient, Enjoyable Driving

Long-Term Goals:
Human cohabitation with intelligent robots

Open Issues:
Fail-safe, Control transitions, Performance Metrics, standards, evaluations, multi-agents, cooperation, etc. etc.

Thanks!
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