State of the Art in Vehicle Automation

Systems and Functionalities today

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Vehicle Automation

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Vehicle Automation

Vision of Automated Driving

source: Mechanix Illustrated 1955
Vision of Automated Driving


Historic View on Driver Assistance

- Speed indicator: objective measurement of the velocity

[http://upload.wikimedia.org/wikipedia/commons/6/6e/1913_Ford_Model_T_Speedster_dashboard.JPG](http://upload.wikimedia.org/wikipedia/commons/6/6e/1913_Ford_Model_T_Speedster_dashboard.JPG)
Historic View on Driver Assistance

- Electric starter: eliminates crank handle starting


Historic View on Driver Assistance

- turn signal reset
  - eliminates manual reset
- Synchronized manual transmission
  - eliminates throttle application
- Servo for breaking and steering
  - reduced force required from the driver
- centralized door locking (incl. remote control)
  - enables opening and locking without access to respective door
- automatic transmission
  - eliminates manual gear shifting
- Oil level indicator
  - eliminates dirty hands
- Anti lock breaking (ABS)
  - increased stability during braking

**Historic View on Driver Assistance**

- **Park Assist**
  - parking without bumps and scratches
- **Electronic Stability Program (ESC, ESP, DSC, ...)**
  - improved stability within physical limits
- **Brake Assist**
  - reduced braking distance in emergency braking situations
- **Navigational Systems**
  - eliminates map in driver’s hands
- **Climate Control**
  - controls interior temperature to comfortable level
- **Night vision**
  - enhances driver’s perception range in darkness
- **Cruise Control**
  - maintains vehicle velocity

**Conclusion**
- none of the previous examples is required for mobility
- nevertheless driver assistance is an indispensable part of vehicle equipment
- advanced driver assistance systems also take over primary driving tasks

**Main success factor**
- Relief of inconvenient tasks
- Increase of safety
- Complement or supplement of human skills
Advanced Driver Assistance

• Definition
  – Advanced Driver Assistance Systems, or ADAS, are systems to help the driver in the driving process.
  – When designed with a safe Human-Machine Interface it should increase car safety and more generally road safety.

Source: http://en.wikipedia.org/wiki/Advanced_driver_assistance_systems

Advanced Driver Assistance

• Advanced Driver Assistance Systems
  – take over some of the primary driving tasks from the driver

• Examples
  – Lane Departure Warning
  – Lane Keeping
  – Adaptive Cruise Control
  – Forward Collision Warning
Driving Tasks

- **Primary Driving Tasks**
  - are required to get from current position to destination
  - Navigation
  - Maneuver (e.g. lane change)
  - Trajectory (e.g. velocity, steering, stabilization)

- **Secondary Driving Tasks**
  - control operation point of vehicle (throttle, brake, gears)
  - turn signal, wiper, light, ...

- **Tertiary Driving Tasks**
  - control ambience
  - radio, phone

Top Technologies for Mature Drivers

The Hartford Center for Mature Market Excellence and the MIT Age Lab conducted an extensive survey to better understand how drivers 50+ perceive and use new vehicle technologies.

1. Blind Spot Warning Systems
2. Crash Mitigation Systems
3. Emergency Response Systems
4. Drowsy Driver Alerts
5. Reverse Monitoring Systems
6. Vehicle Stability Control
7. Lane Departure Warning
8. Smart Headlights
9. Voice Activated Systems
10. Assistive Parking Systems

Source: thehartford.com/lifetime

Assistive Parking

Assistive Parking Systems

Source: thehartford.com/lifetime
Voice Activated Systems

Source: thehartford.com/lifetime

Smart Headlights

Source: thehartford.com/lifetime
Smart Headlights

source: AARP, https://www.youtube.com/watch?v=Z6EKKYc5kaw

Lane Departure Warning

Source: thehartford.com/lifetime
Vehicle Stability Control

- **Antilock Braking System (ABS)**
  - prevents the wheels locking up (or ceasing to rotate) while braking
  - ensures that vehicles remain steerable and maintain directional stability even during emergency braking

- **Traction Control System (TCS)**
  - prevents the driven wheels from spinning when accelerating

- **Electronic Stability Program (ESP, ESC, DSC, ...)**
  - controls vehicle dynamics
  - ensures stability and keeps the vehicle on course by rapid intervention in the engine and braking systems
  - Detects and controls rotational movements of the vehicle
  - ESP intervention often goes unnoticed by the driver

Vehicle Stability Control

- **Fifth Gear visits Bosch Winter Testing Proving Grounds**
Reverse Monitoring Systems

Reverse Monitoring Systems

source: https://www.youtube.com/watch?v=PM50J_57lJA
Drowsy Driver Alerts

Source: thehartford.com/lifetime

Drowsy Driver Alerts

source: https://www.youtube.com/watch?v=hFoakvIYBo
Emergency Response Systems

Crash Mitigation / Avoidance

→ Crash Avoidance Systems

Source: thehartford.com/lifetime
Crash Mitigation / Avoidance

source: Bosch, http://www.youtube.com/watch?v=fhLzFL3EYPY

source: http://www.6d-vision.com/home/bedeutung
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In Addition

- Adaptive Cruise Control
- Night Vision
- Traffic Jam Pilot
- Automated Driving
Adaptive Cruise Control

source: Bosch, see also: http://www.youtube.com/watch?v=own_VaR29fM8

Night Vision

source: http://www.youtube.com/watch?v=DojthARCO6k
Traffic Jam Pilot

Piloted driving assists in traffic jams

source: http://youtu.be/inP5e5yYbc

Bosch Automated Driving

source: http://youtu.be/0D0ZN2tPfho