The Growing Role of Electronics in Automobiles

A Timeline of Electronics in Cars

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by

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Introduction to Clemson University

- A Land-grant University Founded in 1889
  - Focus on Agriculture and Engineering
  - Tradition of Economic Transformation in Agriculture, Textiles, Ceramics, Chemicals

- Technically Oriented Public Research University
  - 17,000 Graduate and Undergraduate Students
  - $220 Million in Research Expenditures
  - Strength in Engineering, Architecture, Agriculture, Entrepreneurship and Communication
Unparalleled Access to the Market Place

More than 1,000 automotive assemblers and suppliers within a day’s drive of Greenville
CU – ICAR Campus
Major Systems

- FEV Engine Dynamometer
- MTS Road Simulator in Weiss Environmental Chamber
- 4-Wheel Chassis Dynamometer in Anechoic Chamber
- Zeiss Full Vehicle CMM
- ETS-Lindgren EMC Chamber
The Impact

- Emissions
- Safety
- Energy
- Manufacturing
1930s
Commercial introduction of the fitted car radio came in from the Galvin Manuf. Corporation.

1952
Blaupunkt became the first maker to offer FM receivers.

1956
Ford Motor Company introduced dealer-installed 8-track players as an option on most models.

1965
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1970s
Compact Cassette Wins the war with 8-track for automobiles.

1980s
GM offers Emergency services and system monitoring.

1990s
Compact Disk Wins the war with tapes for automobiles.

1997
Mercedes offers GPS.

2002
Honda Odyssey factory installed DVD player.

2003
Manufacturers offer a car radio capable of CD, MP3, XM satellite radio and AM/FM playback.

What Next?
CAN Introduction

- Controller Area Network, introduced by Bosch, 1986
- Serial bus for distributed control system
- Twisted-pair media used with bandwidth up to 1 Mbps and 40 devices.
- ISO 11898 (1 Mbps) and ISO 11519 (125 Kbps)

Source: Xilinx
MOST Topology

Source: Yazaki
Automobiles are Complex Electronic Systems

Functions typically controlled electronically include:

<table>
<thead>
<tr>
<th>Engine ignition (spark, timing)</th>
<th>Entertainment systems</th>
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</thead>
<tbody>
<tr>
<td>Fuel injection</td>
<td>Braking (anti-lock brakes)</td>
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<tr>
<td>Emissions controls</td>
<td>Steering (steering assist, 4-wheel steering)</td>
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<tr>
<td>Collision avoidance systems</td>
<td>Seat &amp; pedal positions</td>
</tr>
<tr>
<td>Heating/air conditioning</td>
<td>Communication systems</td>
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<tr>
<td>Navigation systems</td>
<td>Safety systems</td>
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<tr>
<td>Suspension systems</td>
<td>Noise cancellation</td>
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<tr>
<td>Transmission controls</td>
<td>Security systems</td>
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<tr>
<td>Lights, horn, wipers, defrosters…</td>
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</table>

- Current automobile designs have nearly 100 microprocessors
- Number of processors expected to double in 5 years.
- A typical automobile contains about 5 miles of wiring.

It is all about systems integration
Automated Parallel Parking

- Available on Lexus LS460
- Optional on Toyota Prius
- Similar system by Bosch available in 2008
Lexus Automatic Parking
Chassis / Vehicle System Electronics

- Hybrids
  - Charging / Discharging
  - Performance
  - Plug-in
  - Torque vectoring

- Power control

- Safety systems
  - Anti-rollover
  - System monitoring
Modularity

GM Skateboard

BMW Life Drive (i3)
Plug-In Vehicles are Just the Start
Tractor on Snow / Ice – Maneuvering
Tractor Trailer on Snow / Ice
New ESC Challenges

- Increased flexibility
- Variable CG
- Lighter weight

UMTRI (Winkler)
Increased Vehicle Automation
What’s Next?

- GPS, RADIO, Wireless internet, Cell Phone integration…
- 3-D Navigation (Google, NVidia, Volkswagen)
- Car to Car LAN
- Car to Infrastructure LAN
- Reconfigurability
Game to Vehicle Technology
The Future for the Car

- Performance
  - Fuel economy
  - Emissions
  - Safety
  - Handling

- Infotainment

- Security (a virus?)

- Haptics – driver feedback

- Systems integration

- Policy
  - Safety systems (e.g., airbags, tire pressure sensors)
  - Responsibility

- The “Camera” scenario
The Future for the United States

- Education at all levels
- A Single State
  - Jobs – too many?
- The Southeastern U.S.
- The United States of America
  - Automotive
  - Manufacturing
- The World

In times of change, learners inherit the earth; while the learned find themselves beautifully equipped to deal with a world that no longer exists. (Eric Hoffer 1902-1983)
Do Not Underestimate the Human Factor