Building Immersive User Interfaces

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Software driving automotive innovation

• “...more and more that’s exactly what today’s cars and trucks are: highly sophisticated consumer electronics...”
  - Rick Wagoner, General Motors CEO (CES 2008 Keynote)

• “Many of GM’s products have become reliant on software to the point that they could not be sold, used, or serviced without it.”
  - Dr. Anthony Scott, General Motors (1)

• “We believe that advanced technology in electronics and software will drive 90 percent of product innovation in the automotive industry for the next 10 years.”
  - Sangkwon Kim, Hyundai Motor Co. (2)

• “40% of a vehicle's cost is determined by electronics and software.” - BMW (3)

• Projections are that software alone will soon account for over 12% of the value of a car. - Matt Volckmann, VDC (4)
Software driving automotive innovation

• “VW employs more than 700 researchers in Germany, the USA, China and Japan. They are continually striving to network the car more intensively to its environment, to other vehicles and finally - via intuitively operated human-machine interfaces - to the drivers themselves.” (5)

“Our frustrations with machines are not going to be solved with better machines. Most of our technological difficulties come from the way we interact with our machines…” - Dr. Donald Norman (7)
OEM investment versus differentiation
Software impacting quality

Percentage of recalls due to software

Source: National Highway Traffic Safety Administration (NHTSA) (6)
Automotive trends and software challenges

– Personalization
  • My devices
  • My media
  • My look and feel
  • My services
  • My content
  • My location

– Challenges
  • Complexity
  • Quality
  • Ease of use
  • Driver distraction
  • Connectivity
  • Updates
HMI design challenges

- Increasing pressure for market differentiation
  - HMI is now one of the biggest single differentiators

- Increasingly sophisticated customer expectation
  - Rich, multi-modal, dynamic HMI
  - Consistency, ease of use and familiarity
  - Location aware interface / content

- Integration with external consumer electronics and services
  - e.g. cellular phones, MP3 players
  - Synchronization, communication, and control
  - System and component software upgradeability to keep up with the consumer electronics market
  - Off board services / internet

- Digital media integration
  - Formats, codecs, filesystems and DRM

- Driver distraction
HMI design challenges

- Reduce cost of development
  - HMI can consume over 50% of a project resources
- Shortened design cycles
- Leverage latest consumer and desktop technologies with:
  - Lower-cost CPU
  - Smaller flash and RAM footprint
  - Much faster startup times
  - Automotive grade reliability
  - Predictable response times
  - Smoother animations / transitions

All without compromising traditional real-time tasks!
HMI concepts — example

HMI

User Control

Video

Navigation

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The OS dimension

- The operating system plays a key role in the user experience and must:
  - Be highly customizable and support fast-booting
  - Provide real-time priorities and scheduling for each HMI subsystem (layer) and OS service
  - Offer open and lightweight communications between HMI subsystems and OS services
  - Support on-the-fly partitioning of OS-level resources (CPU, memory, etc.) between the HMI and other sub-systems
  - Provide automotive grade reliability
  - Modularity to implement component level repair / upgrade / update

QNX Neutrino provides all these capabilities
QNX Aviage

Aviage HMI player

Rapidly build rich Flash-based user interfaces with video effects and animations

Aviage Multimedia Suite

Discover, play, sync and organize media

Aviage Acoustic Processing

High-quality, hands-free communication without costly dedicated speech processors

Before

After
Adobe Flash for your HMI

- Quickly jump from prototype to product
- High-level tools, millions of developers and designers
- Mountains of Flash content: components, movies (YouTube), source code, etc.
- Consistent look-and-feel for all flash content on all players
- Adobe has been targeting embedded systems for several years
  - Almost all phones support Flash Lite 2
  - Targeted for an embedded environment (footprint, cpu usage, etc.)
QNX and Adobe Flash

- **QNX Aviage Flash HMI Player**
  - Incorporates Flash into QNX application frameworks
    - Launch and control Flash content
    - Enable Flash content to coexist with other graphics and OS services
  - Adds QNX embedded values to Adobe Flash player and its environment
    - Reliability
    - Performance
    - Scalability
  - Adobe Certified
QNX Aviage graphics suite

Native applications

- OpenGL ES
- OpenVG*
- Image support
- Font support

QNX graphics framework

Flash applications

Adobe Flash player

Graphics driver
Robust, “Connected”, Automotive HMI

Action Script
- OS independent
- CPU independent
- Safe execution environment
- Trained workforce
- Most advanced HMI builder in the world

Flash Player
Native

TCP or QNX messages

Gateway
Native

Flash to QNX
Gateway

Native apps can share the display. Flash can alpha-blend overlays.

QNX Resource Managers

MME
Native
Phone
Native
Browser
Native
DVD
Native
Navigation
Native

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Audi Q5
Audi Cross Cabriolet Concept
Contact Information

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Thank You!!
Backup

- Sources:
  - 2 - Sangkwon Kim, Senior Executive Vice President of Hyundai Motor Co.'s Research and Development Division - 2002
  - 4 - Matt Volckmann, senior analyst at VDC 2006
  - 7 - Dr. Donald Norman via New York Times - Dec 18th 2007
QNX Strengths

• Standards-based OS
  – POSIX compliant (application portability)
    • Linux and Unix knowledge base and developers without IP risks
  – OpenGL ES, Open VG, etc.

• Standards-based tools
  – QNX Momentics Tools are based on Eclipse industry standard
    • www.eclipse.org: hundreds of third-party tools

• Reliability
  – QNX microkernel architecture and MMU permits reliable, self-healing design

• Scalable and realtime
  – Components based
  – Scalability without affecting realtime response
  – Multi-core - Symmetric, Asymmetric and Bound Multi-processing support

• Clean IP
  – No viral GPL or other licensing restrictions

• Automotive and Consumer Middleware
  – Multimedia Suite
  – Advanced 2D and 3D Graphics (OpenGL ES)
  – Adobe Flash for rich immersive HMI
  – Acoustic Pre-Processing

• Rich automotive ecosystem
Extensive Automotive Experience

Silicon relationships

QNX

Suppliers

LG Electronics
AISIN
 Valeo
Visteon
Samsung
JVC
HYUNDAI AUTO E
SIEMENS VDO
DENSO
DELPHI

QNX is in over 180 Vehicle Models

Middleware

Navigon
VoiceBox
Open Interface
EB
Temic

Auto OEMs

QNX

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VW Electronics Research Lab

• The ERL Vision
  • Expand VW Group technology road map with cutting edge technologies

• Research Areas
  • Connected Vehicle
  • Multimedia Integration
  • Human Machine Interface
  • Driver Information and Assistance
  • Testing Concepts and Validation
Prototyping User Interfaces

- Automotive HMI development cycle:
  Designer -> Implementer -> Supplier -> Developer

- Flow + Animations
- Wireframes
- Flash
- State charts
- HMI Designers
- Graphic Layout
- Artists
- Code in C/C++
  OpenGL, OpenVG Widgets
  Developers
- 2D / 3D Animations
- Collada
- 2D Assets
- Illustrator
- C/C++
- SDKs
- Java
Prototyping User Interfaces

- Iterative prototyping provides opportunity for enriching and improving brand identity
- A common tool chain for design and implementation of HMI speeds this process
Potential Product Impact

- Dynamic design over 3-5 year product cycle
- Vehicle specific user interface design
Cross Cabrio Quattro Concept

- Los Angeles Auto Show November 2007
- Infotainment features developed by ERL and Audi Design Center -California
- Design study developed at ERL with help from partner companies
Cross Cabrio Quattro Features

Media features
- Internet streaming radio concept
- Destination entry with geo-encoded imagery
Cross Cabrio Quattro Features

Navigation Features
- Online point of interest searching
- 3D navigation satellite imagery concept
Cross Cabrio Quattro Features

- PC application structure
  - Flash, 3D graphics application, framework

![Diagram showing PC Based Software Application]

- Accelerated Graphics Application
  - OpenGL 3D Libraries

- Background Application (C)
  - Screen Layer Control
  - Driver / File System Interface

- Flash Player
  - HMI Logic Actionscript
  - XML Socket Class

- Socket Server
Embedded Flash Ecosystem

- Flash composited with native applications
- HMI server provides device interfaces
- C/C++ local code extensibility from Flash
Handbook Application Study

Design goals:
• Intuitive structure for digital user manual
• Utilize Flash XML data class functionality
• Focus on graphics and information density
Handbook Application Study

- Flash Lite 3.0 Software structure
- Actionscrip HMI Description
- XML Data Structure
- FLA Graphics library
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