Philipp Hudelmaier discusses how microcontroller technology can influence multimedia trends, balancing safety and security against ergonomics and entertainment.

The integration of the latest semiconductor technologies are key elements for innovation in the infotainment systems of the future. For the driver, however, these aspects will be beneficial only if ergonomic human-machine interaction can be assured, and road safety issues are not adversely affected.

Ideally, the infotainment systems for the vehicles of the future will offer an ergonomically designed human-machine interface that improves the driving experience while at the same time accommodating a range of safety features. Thus messages from assistance systems must have priority over multimedia functions.

The large-scale expansion of data networks and the growing global availability of the mobile internet have seen contemporary multimedia trends such as smart phones, tablets, apps and social networks gain enormously in importance for consumers over the past few years.

All over the networked world, its users have been captivated and influenced by the accessibility of a rapidly growing number of online services at home, in the office or while out shopping. Users now expect to be able to contact anyone at any time, to be always online and able to access any data they require, wherever they are. Accordingly, users also want the infotainment system in their own vehicles to reflect the functionality and options available to them in their online world.

This situation produces multiple, simultaneous challenges for semiconductor manufacturers, system suppliers and car makers. While the product life cycle in the automotive industry is about three years long, consumers in...
the market for smart phones and
tables wait barely 12 months for
the next product. In addition, the
ultimate goal of networking the
vehicle with its environment and
the integration of online services
generate new security risks for
vehicle electronics. Above all, every
single new feature added must be
integrated into a harmonious and
ergonomic HMI (human-machine
interface) in such a way that
these features improve the driving
experience but are not themselves a
source of distraction.

Today's infotainment
In August 1932, at the Berlin Radio
Fair, Blaupunkt presented Europe's
first car radio - at the time an
exclusive luxury product. In the
meantime, these former radios
are now just one part of modern
in-vehicle infotainment systems.
Infotainment systems combine
both functions: information and
entertainment. The latest generation
of systems replaces many different
standalone units, combining
applications for navigation,
multimedia, communications and
vehicle functionality.

For route planning, modern
navigation systems factor in the
current traffic situation, display
high-resolution 3D mapping data
for both countryside and cities,
and provide an integrated sim
card for mobile internet access,
so as to overlay weather data or
photos of tourist attractions at the
destination, for example.

Multimedia features offered
include analogue and digital radio
reception, plus the ability to play
all the standard audio and video
formats. Systems are also equipped
with appropriate ports that permit
the connection of external devices
or storage media. Users can
select their desired data source
easily, thanks to intelligent media
management systems.

For communications, Bluetooth
connectivity between the user's
phone and the infotainment system
is a prerequisite. In the luxury
car segment, passengers have an
in-vehicle wlan at their disposal,
with the system creating an
internet connection via the driver's
mobile phone. To interact with
the infotainment system, drivers
can make use of voice commands
or text-to-speech features, which
enable the system to read out any
newly-received emails during
the journey, for example. Other
elements of the HMI include jog
dials or touch screens.

Occasionally, on-board features
will include diagnosis functionality
that keeps the driver updated on
the vehicle's operating status and
upcoming service intervals. Such
features also include camera-driven
driver assistance functionality,
which can help when parking the
vehicle or negotiating low-visibility
traffic situations. Infotainment
systems can even configure vehicle
drive modes or offer the choice of a
gear-shifting programme.

Limitations
In-vehicle implementation of
the current crop of multimedia
trends is limited by restrictions
to on-board connectivity. Room
for improvement exists both in

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the area of vehicle connectivity with external devices and in the networking of the vehicle with its environment. On the one hand, pairing the mobile phone to the infotainment system does not always work as smoothly as intended - nor is 100% compatibility assured. On the other hand, accessing web pages from the vehicle can often be frustrating, since the slow Edge technology is still often the transmission protocol used. To date, options for updating in-vehicle software online or providing access to apps or cloud services are available in only a handful of systems. This is an area where car makers still view their exposure to security risks as being too high.

As infotainment systems offer more and more applications, they become increasingly complex and harder to use. Certain features can be accessed only with difficulty, and even voice control systems are often time consuming, as drivers have to go through screen after screen to reach their chosen menu option. In addition, voice control is limited to only a few functions, so entering a URL, for example, becomes a laborious exercise in using the jog dial.

As for graphics performance, the hardware embedded in the infotainment system still lags behind typical consumer electronics products, which always feature the latest video technology. The reason for this is that in-vehicle semiconductors must satisfy a specific set of requirements governing their temperature range, durability and long-term availability. To satisfy current quality standards, the software applications these chips run must also undergo lengthy testing procedures.

**Catching up**

To benefit earlier from technological advances in the consumer goods segment, the automotive industry's next generation of infotainment systems will need to compensate for the limitations described in the previous section, that is those affecting the topics of connectivity, security, HMI, and graphics performance.

One basic precondition for improved in-vehicle consumer-level features is the availability of interfaces to connect external devices and storage media, plus the networking of the vehicle with its environment. Smart phones or external music players can communicate with the in-vehicle infotainment system via Bluetooth, wifi or USB. In the future, problems with mobile phone pairing should be alleviated by the near-field communications (NFC) set of wireless standards, which enable automatic authentication between mobile phones and hands-free systems. Running applications on the mobile phone via the in-vehicle HMI is one application of Mirrorlink technology. For future systems, the HMI mobile high-definition link is a proposed technology for the streaming of HD format video data from smart phones or tablets to the infotainment system, with HDCP (high-bandwidth digital content protection) being one kind of data stream supported. This will become especially interesting once infotainment system displays are able to offer HD resolution.

To enjoy services such as video streaming, voice-over-IP telephony or music downloads, a fast data connection is essential. This kind of connection is offered by the new mobile LTE long term evolution standard, which supports download rates of up to 150Mbit/s. When combined with a wlan hotspot in the vehicle, all its passengers can then enjoy a fast, reliable internet connection.

**Eye on safety**

The dangers that could result from the malicious hacking of vehicle controls were demonstrated in 2010 by a US research team. In an experiment, the team managed to use the vehicle's on-board diagnostics port to gain control of the engine and brakes, and to manipulate the text displayed on the instrument cluster. The driver had no chance to counter such attacks. This shows that networking the vehicle with online services, local infrastructure or other vehicles offers potential entry points for malicious hacking attacks.

In the infotainment system's head unit, entertainment functionality is closely integrated with safety-critical applications - such as the camera-driven parking assistant or the visualisation of data from the instrument cluster. In next-generation infotainment systems, manufacturers must ensure that this kind of set-up - where critical systems coexist with less critical systems - does not permit any unintentional interactivity.

If this is not assured, any networking with the internet, the car maker's data centres or cloud services could rapidly develop into a threat to vehicle security and safety. These kinds of security questions are just some of the issues being discussed by the Genivi Alliance, which is developing an open source platform for in-vehicle infotainment systems.

**Human-machine interaction**

Thanks to the integration of smart phones, the availability of rapid data connections and access to cloud services, the range of data and applications available in vehicles is growing exponentially. Apps, business features and real-time traffic information are all competing with safety-relevant warnings generated by driver assistance systems. While these innovations should improve the driving experience, they must not...
adversely influence road safety. This is the challenge that must be met by the designers of HMI systems.

Usability can be simplified by the adoption of voice recognition, text-to-speech and gesture recognition systems. For touch applications with character recognition, microcontrollers exist that provide a high-speed SPI interface for connection to external flash memory.

**Better graphics**

Graphics requirements for the next generation of infotainment systems will focus on 3D graphics performance, HD video and audio, while keeping power consumption low. The real challenge, however, is ensuring that the latest chip technology is integrated into vehicles as fast as possible. This will require improvements in the qualification processes for automotive-sector semiconductors.

In addition, systems will need to be designed in such a way that predefined interfaces can permit the replacement of hardware components. The use of software standards – such as Open GL, for example – will also enhance application portability. This will offer the chance of upgrading to the latest technology at any time.

This kind of approach will require collaboration between semiconductor manufacturers, system suppliers and car makers even at very early stages of development. Such work will include the joint definition of development roadmaps, for example, and conceptual design work that envisages scalable and modular system architectures. Displays in the infotainment systems of the future will very likely feature full-HD resolution.

To avoid latencies and loss of quality, one recommendation is to implement communications between the display and the graphics engine using Pixel Link, which supports uncompressed image transfer.

Philipp Hudelmaier is systems engineer for Fujitsu Semiconductor Europe.

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