Road safety is experiencing a centrifugal pull. On the one hand, the widespread introduction of airbags, antilock brakes, improved traction control systems, enhanced crashworthiness and better roads has reduced the number of fatalities. In fact, in the past 10 years traffic-related deaths across Europe have declined by 36%. At the same time, though, with the increasing use of mobile devices, portable music players and navigation systems in-vehicle, there is a growing trend towards driver distraction that runs counter to all the positive effects.

Studies show that drivers using mobile phones are four times as likely to cause an accident. Furthermore, someone talking on a phone is as likely to be involved in an accident as someone with a 0.08 blood alcohol content level – the point at which many countries deem a driver to be intoxicated. In the USA and Europe, it is estimated that at least 10% of drivers are talking on their phones at any given time. Both phone makers and auto manufacturers acknowledge these risks but continue to develop and advertise systems, computers and gadgets that can contribute to such problems.

David Strayer is a psychology professor at the University of Utah and has developed a US$100,000 simulator in which volunteers drive while texting, talking and generally multi-tasking. Based on these investigations, Strayer has shown that drivers are eight times more likely to have an accident while texting – and that half of those talking hands-free will miss their exit. “Our return on investment for those billions spent on improving driver safety is zero,” he said. “That’s because we’re using devices in our cars.”

As driver distraction is the hot traffic safety topic at the moment, with mobile phone and navigation devices the focus of much attention, we ask how advances in HMIs can ensure drivers remain connected yet safe.

Talking cure
“I nearly missed my exit the other day,” adds Todd Mozer, founder and CEO of one of the most established speech recognition companies, Sensory Inc. “It really hit home how being in a phone conversation distracted me.”

Most of us are aware of the dangers of using such devices yet we continue to do so, creating what Matt Richtel of the New York Times refers to as “a disconnect between our risk assessment and our behaviours” (see sidebar, Why we drive and dial). Mozer believes that the only true way to rid our minds of distraction is to make driving our sole focus. This would mean turning off the stereo and any mobile device we have. But of course few of us do this, which is why the growth of the Human Machine Interface (HMI) is so important today.
“Speech recognition doesn’t eliminate the risks but is a great way of improving safety,” Mozer explains. “Until five years ago, everything was still knobs and buttons. With the likes of the Ford SYNC, the industry has moved into the realms of hands-free calling, turn-by-turn directions and music search for the masses. Recently we have raised this up a level by developing our Truly Handsfree Trigger (THT) – a voice technology that makes devices come alive with one spoken magic word and is completely hands-free.”

Look, no hands
Voice search is increasingly deployed in smartphones to access data and increase hands-free capabilities for safety and convenience. In October, Sensory announced the availability of Android and iPhone software development kits that enable smartphones to sync with Sensory’s THT. That same month, Vlingo became the first smartphone application provider to incorporate THT into its Vlingo InCar application. “We have known for some time that consumers don’t want to always have to hit buttons to call up voice search applications,” says Vlingo CEO David Grannan. “Now it’s possible to create a real voice user interface without relying on touch.”

Why we drive and dial
We may deny it but research shows that most of us still talk on our mobile phones while driving. The big question, though, is why? Scientists claim it is partly due to the social pressures of staying in touch with family and friends. On top of that, while we are driving it is almost impossible to observe any noticeable dip in our own attention.

John Ratey, an associate professor of psychiatry at Harvard University specialising in the science of attention, believes that many of us are addicted to our phones, and that the neurological response of this kind of multi-tasking manifests itself as a burst of adrenaline, or ‘dopamine squirt’. Without it, we get bored with ‘ordinary’ activities such as driving. “We need that constant pizzazz, the reward, the intensity,” Ratey says, adding that the modern brain is being rewired to crave stimulation – a condition he calls acquired attention deficit disorder. He also dismisses the notion that people feel the need to be productive while driving. “The justification for doing work is just that,” he says.

“OUR VISION IS TO CREATE SPEECH RECOGNITION TECHNOLOGY WHERE YOU TALK AS IF YOU ARE TALKING TO A FRIEND IN THE PASSENGER SEAT”

THT enables a device to be placed into ‘listening’ mode while waiting for a key word. When the word is uttered, the device wakes up and awaits the next command.

“In the past, speech recognition worked when you defined when you were going to start and stop talking by pressing a button,” Mozer explains. “This is different – by just saying ‘Hey Vlingo!’ you’re away. Forget touch or gesture: in 10 years’ time the car will be all about speech.”

Talk to me
“Our vision is to create speech recognition technology where you talk as if you are talking to a friend in the passenger seat,” says Martin Reber, CEO of SVOX, specialists in speech solutions for embedded automotive applications. The Swiss firm is currently working with Volkswagen Group Research in the area of Natural Language Understanding voice interfaces (see sidebar).
Dictation

Nuance Communications is a world-renowned expert in the field of voice recognition. Working alongside the likes of Ford, BMW, Audi and GM, the company enables drivers to apply voice technology to radio and track selection, dial-by-voice, onboard navigation, and email and SMS reading.

“Although it is clear there is a correlation between speech recognition and driver safety, our research has also shown that the way the system is designed is vital,” says Arnd Weil, general manager for Nuance. “We’ve found that if you have multiple steps to enter an address on a navigation system, you will still see improvement in driver distraction but the improvement is not as good as one-shot command – i.e. saying the address in one go and only having to look at the screen for confirmation once rather than multiple times. We have made a huge priority of one-shot commands.”

Nuance is currently working on SMS dictation for the car, which according to Weil will be available from 2012. “So far you can only listen to SMS and emails, but soon you will be able to dictate them too,” he says. Nuance is acutely aware that while some in-car innovations may be beneficial, they can still create more problems than they solve. “We realise that the safest driving takes place when there is no distraction whatsoever,” adds Nuance’s vice-president of communications, Richard Mack. “This is why we haven’t promoted some of our mobile solutions that allow for web search for the iPhone or Blackberry, on account of their minor manual and visual component. In reality, though, a ‘pure’ driving experience does not exist today, and is nearly impossible to achieve.”

Although the likes of Mozer believe the future is “all about the voice”, there are other HMI that can undoubtedly improve driver safety.

HUD suckers

Safety, navigation and infotainment systems are rarely optimally integrated into vehicles. Data that is critical to decision making is often displayed in multiple locations – on a centre console, LCD or instrument panel, for instance. This can make it difficult for the driver to assimilate such data quickly and safely. The driver could therefore benefit from a visual interface that focuses his attention on the road ahead. The best of these is the head-up display (HUD).

HUDs have been around since General Motors first installed one way back in 1988. In 2003, BMW became the first European manufacturer to offer HUDs. Today, all Corvettes sold in the USA and Priuses sold in Europe have them, as do many BMWs and models in the Lexus range.

Information available on the instrument cluster – such as speed, fuel, temperature, indicators and warning lights – may all appear on a Heads-Up Display (HUD). From a safety perspective, the likes of active cruise control, lane departure and rear collision warnings can be vastly improved when implemented with HUD. “Driving is a visual endeavour and keeping the driver’s eyes focused on the road is the best way to address the problem of driver inattention,” says Maarten Nieston, head of Business Development for Microvision.

Human-Machine Interfaces

Several studies have attempted to show the dangers of texting while driving. One such study conducted in 2009 showed that at 35mph the average unimpaired driver took 0.5 seconds to brake. The drunk driver took an extra four feet to stop, a driver reading an email an extra 36ft, and one sending a text a staggering 70ft.

A large-scale study by the Virginia Tech Transportation Institute also carried out in 2009 observed that of 4,452 safety-critical events it recorded, 81% of these involved some type of driver distraction, and that those texting while driving were 23 times more likely to experience a safety-critical incident. The study also discovered that drivers typically take their eyes off the road for four out of six seconds when texting, and 4.6 out of six seconds surrounding safety-critical events.
“THE ULTIMATE AIM IS TO MAKE IT EASIER TO USE SPEECH DIALOGUE SYSTEMS”

explains Jim Buczkowski, director of Ford electronics and electrical systems engineering.

With this latest iteration of SYNC, users can control the system without having to learn nearly as many commands than the original version – will help to deliver a more conversational experience between car and driver. “The improvements we’ve made will make it easier for drivers to use and interact with it, even those customers who have never used voice recognition before,”

As well as complete sentences, isolated utterances, such as ‘Claes Tingvall. Call!’, can also be spoken. A form-based dialogue system guides users until the voiced goal is accomplished.

Voice operation developments such as those from SVOX and Nuance reduce visual effort for the driver, as well as mental effort. Professor Mark Vollrath from the Braunschweig Technical University investigated in-car distractions in 2008 and agrees that such technologies have true potential for enhancing safety. In his study, Vollrath stated that the manual operation of in-vehicle information systems results in a significant decrease in driving performance, even in relatively simple driving situations, such as lane keeping and lane change. “Voice-operated systems that do not use speech throughout the entire process and require the driver to check information visually are problematic,” he says. “In difficult driving situations such as lane change, even the best voice-operated system in my study (audio) showed a decrease in performance compared to driving without operating any in-vehicle systems.” Obviously, concentrating on a system can still be distracting even if the driver can keep his eyes on the road the whole time. “In my view, this represents the limits of system design. But this level of distraction is comparable to chatting with a passenger or being deep in thought. In such cases, we should not look to make changes in the design of the information systems, but consider other possibilities such as ADAS.”

provides images directly in front of the driver’s eyes, the display applying a colour scheme to highlight a pedestrian or animal, thereby seamlessly alerting the driver.

3D good, 2D bad

Many believe that existing in-car navigation systems distract the driver’s gaze from the road, and that the 2D maps on the display create a lag as the brain interprets the information and applies it to the route. A preferred use of HUD technology would therefore be to provide some kind of 3D navigation system with directional arrows that are bright enough to gain the driver’s attention but do not obstruct his view or distract him from the job in hand. Enter MVS-California.

“In the past, attempts to create an effective HUD for navigation have been unsuccessful,” says Juliana Carnes, MVS’s chief operating officer. “In some cases, the lines on the screen obscured pedestrians, in others the
The world of phonemes

Mercedes-Benz has been integrating voice-recognition systems in some of its premium vehicles since 2000. Back then, you’d have to spell out commands letter by letter. Nowadays, Linguatronic is much more advanced. The system is, Mercedes-Benz engineers feel, a major contribution to road safety as drivers no longer need to take their hands off the steering wheel to operate mobile phones, navigational and audio equipment. Speech synthesis technology is also used to read out traffic information affecting a specific route, or even SMS messages. During the brief dialogue between the driver and Linguatronic, the sound signal is digitised, converted into a frequency range and finally analysed. Within milliseconds, the computer extracts various characteristics from the speech signal in order to recognise what are known as ‘phonemes’. To the linguistic scientist, these are the smallest sound components of a language, and decisive for understanding the words. The control system recognises words by combining the phonemes and comparing the result with a phoneme dictionary stored in memory. Each language has its own, typical phonemes; Linguatronic uses around 40 for the German language. Linguatronic processes the phonemes as digital codes. The electronics instantly check each sound, joining the different phonemes together and also verify acoustic probability of the word. So that even fine nuances in pronunciation are recognised reliably, engineers devised a background noise suppression feature, meaning that commands can be recognised even at higher speeds and in a convertible vehicle.