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Voice Technology: Answering Europe's Call for Safer Automotive Controls

By Dani Cherkassky, Kardome

The automotive industry faces a turning point as European regulators push back against the touchscreen-centered dashboard design that has defined vehicle interfaces for more than 15 years. Beginning in January 2026, the European New Car Assessment Program (Euro NCAP) will require that to qualify for five-star safety ratings, every new car sold in the European Union will need to feature physical buttons or switches for critical functions such as turn signals, hazard lights, the horn, windshield wipers, and eCall.

This regulatory pivot responds to mounting evidence that touchscreen-centric interfaces increase driver distraction and compromise safety. As Matthew Avery, director of strategic development for Euro NCAP, recently said, "The overuse of touchscreens is an industry-wide problem, with almost every vehicle maker moving key controls onto central touchscreens, obliging drivers to take their eyes off the road, and raising the risk of distraction crashes."

Alongside a partial return to tactile controls, voice technology is emerging as a compelling complementary solution that could address safety concerns and modern expectations for intuitive control systems. However, implementing effective voice recognition in automotive environments presents unique technical challenges that require innovative engineering approaches.

THE SAFETY CASE AGAINST TOUCHSCREENS

The automotive industry's embrace of touchscreens was driven by several factors: reduced manufacturing costs, easier localization, aesthetic minimalism, and software flexibility. However, the disadvantages have become increasingly apparent through safety research.

Whereas physical buttons can be operated via tactile feedback alone, touchscreens demand visual engagement from drivers. Worse, many functions are buried in multiple menu layers, requiring several swipes or taps to access. This significantly increases the time drivers take their eyes off the road, raising the risk of accidents. Studies show that looking away from the road for just two seconds doubles the crash risk. A Swedish study by Vi Bilägare revealed that drivers needed up to 4.6× longer to perform basic tasks on touchscreens than with physical buttons, which is a concerning safety implication for modern vehicle design.

Euro NCAP's upcoming requirements represent an evidence-based correction to this trend, prioritizing safety over aesthetic minimalism. However, the challenge for manufacturers remains: How can safety be balanced with the technological expectations of modern consumers?

IMAGE: KARDOME

VOICE USER INTERFACE: A COMPLEMENTARY SAFETY SOLUTION

Voice interaction offers an ideal solution to the safety challenges of complex in-vehicle controls. When functioning optimally, voice commands allow drivers to maintain visual focus on the road while controlling increasingly complex vehicle systems.

A scientific study published in Nature assessed driver distraction from in-vehicle information systems and found that voice user interface (voice UI) systems reduce off-road glance behavior compared with visual-manual controls. Speech input reduces the total glance duration and the number of glances a driver must make, improving driving performance.

Natural language presents the most intuitive and effective way to interact with future intelligent vehicles. However, the long-held promise of effortlessly conversing with your car like a friend has yet to be fully realized. Two key obstacles stand in the way: poor performance in noisy environments and the necessity for specific, often unnatural commands.

The car cabin presents a particularly demanding acoustic landscape for voice UI. The confined space contains numerous reflective surfaces, such as windows, that create intricate reverberation patterns. Adding to this complexity is the user's ongoing need to recall precise and awkward command phrases, alongside various disruptive noises including driving and HVAC systems, speed and surface-dependent road noise, competing passenger speech, turbulent wind noise from open windows, and external interference such as horns and sirens.

These challenges explain why early voice recognition systems in vehicles disappointed users, with recognition rates significantly lower than in controlled environments.

TECHNICAL ADVANCEMENTS ENABLING IN-VEHICLE VOICE AI

Recent advances in several key technologies are finally making reliable in-vehicle voice control practical:

Advanced speech signal processing

Contemporary spatial audio processing offers a solution for noisy environments by isolating and enhancing target speech. By deploying multi-microphone arrays within the car cabin and employing directional sound processing

algorithms, "acoustic zones" can capture speech from any location while attenuating unwanted noise. A key consideration, however, is the increased system cost associated with these multi-microphone arrays.

An innovative AI-powered 3D acoustic analysis solution, using a single overhead microphone array, promises to lower the vehicle's component costs while maintaining robust speech enhancement and voice recognition accuracy for up to six "acoustic zones"—a necessity for automotive applications. A recent study by Head Acoustics demonstrated that this advanced system sustains consistent speech recognition rate performance even at high speeds (120 km/h), a condition under which conventional, single-microphone array systems typically falter.

Neural noise suppression

Deep-learning–based noise suppression models can differentiate between speech and various types of vehicle noise with unprecedented accuracy. These systems are trained on extensive datasets of in-vehicle audio to identify and remove noise components while preserving speech integrity.

Unlike traditional statistical models, neural network approaches can adapt to the non-stationary noise profiles typical in automotive environments. This enables higher speech recognition accuracy even as driving conditions change. Recent testing has shown that next-generation, AI-driven speech enhancement technologies can significantly outperform traditional noise reduction solutions across multiple challenging scenarios.

Speaker identification and separation

Beyond creating virtual listening zones with 3D spatial processing, advanced machine-learning models can identify individual speakers within the cabin. This enables a two-tiered personalization system, offering location- and identity-based infotainment settings for each passenger. Furthermore, it enhances security for driver-specific functions such as navigation updates and provides a welcoming experience by loading personalized infotainment profiles for passengers. Today, this can be done with a single microphone array. Previously, such capabilities were available only if the automaker added multiple microphones around the cabin, which increased design complexity and hardware costs.

Context-aware processing

Thanks to today's small language models, you could interact with your car using your natural voice. No more struggling with awkward commands or feeling restricted. The model is purpose-built for the specific functions of your vehicle, tracking vehicle state, recent commands, and driver patterns. These systems can make intelligent predictions about likely commands, improving recognition rates even under challenging acoustic conditions. This represents a significant leap beyond simple voice control, delivering the natural conversational experience you've always wanted in your car.

Edge AI processing

Edge computing augments cloud-based LLMs in voice UIs by handling local queries, reducing latency and bandwidth costs, and enhancing system reliability when the cellular network is unavailable. This shift is particularly advantageous for safety-critical automotive applications, where minimizing command latency is crucial for preventing potential hazards.

THE POTENTIAL OF VOICE UI IN VEHICLES

With these technical challenges addressed, voice technology could transform the in-vehicle experience into a truly intuitive interface that enhances both convenience and safety. Drivers could issue natural commands—such as "I'm feeling cold" or "Find me the quickest route home, avoiding highways"—and engage in contextual conversations. The system would recognize individual users, maintain personalized profiles, and proactively offer assistance based on learned patterns and current conditions, from adjusting climate settings when rain is detected to postponing notifications during complex traffic situations.

Advanced voice systems would dramatically reduce driver distraction by handling tasks that previously required multiple touchscreen interactions. Complex vehicle settings could be adjusted with simple commands, such as "Switch to sport mode." The system could also serve as a central interface for the driver's virtual assistant, allowing tasks such as reading important emails, checking home security systems, or placing food orders for pickup along a route.

THE PATH FORWARD: MULTIMODAL INTERACTION DESIGN

The future of automotive UI likely lies in thoughtfully designed multimodal interfaces that combine physical controls, voice interaction, and visual displays. This approach acknowledges both human factors: research and evolving user expectations.

Critical safety functions require immediate, reliable access through physical controls. Secondary functions benefit from voice control's hands-free advantage, while browsing complex information may still use visual displays when the vehicle is stationary.

Integrating these modalities requires careful human-machine interface design to create a consistent and intuitive experience. A good rule of thumb is that single-touch interaction is optimal for straightforward functions, but when tasks become more complex and require multiple swipes or taps, voice UI becomes a more efficient method. Voice systems must recognize when commands refer to on-screen elements, while visual interfaces should indicate voice command capabilities.

TECHNICAL IMPLEMENTATION CHALLENGES

Several engineering challenges remain for automotive voice systems:

- **Integration with vehicle acoustic design.** Manufacturers should consider using advanced voice AI software systems to avoid the cost/performance conundrum associated with traditional approaches, which require multiple microphones throughout the cabin.
- **Multilingual performance.** European markets require robust performance across multiple languages and accents.
- **Processing efficiency.** Embedded systems must balance performance with power and space constraints.
- **Safety considerations.** By implementing advanced voice AI systems that can accurately identify and process who is speaking, driver safety is enhanced, as drivers and passengers no longer need to fumble with touchscreens, buttons, or controls.

While Euro NCAP is leading this regulatory shift, similar safety considerations will likely influence standards globally. Manufacturers developing for worldwide markets must consider how the European requirements might forecast broader regulatory trends.

CONCLUSION

Despite its historical limitations in automotive contexts, voice technology has reached a technological inflection point where it can serve as a genuine safety enhancement. Through careful integration with physical controls and the thoughtful implementation of advanced acoustic processing, voice AI can help create vehicle interfaces that are both safer and more capable than those using traditional buttons or touchscreens alone.

The coming years will likely witness significant innovation at the intersection of regulatory requirements, safety considerations, and technological capabilities, potentially transforming how drivers interact with increasingly complex vehicle systems. ■

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