

Touch-less control coming to cars



A “high-five” hand position with spread fingers commands the Horizon system without touching. (Visteon)

Use of proximity and gesture-recognition systems in auto cockpits could rise fifty-fold within a decade.

by Steven Ashley

By now many of us have tried out gesture-recognition technology at home; **Microsoft's** Kinect for Xbox and **Nintendo's** Wii video game consoles have been around for several years. And most of us who have tried them out quickly realized how intuitive it is to use natural body movements to interact with computerized devices.

So the question arises: when will the touch-less 3D control technology make it onto the road? With simple hand motions, a driver might adjust the volume, flick over to the next page, zoom in on a screen, raise or lower the heat, or scroll through lists of radio stations or phone numbers.

The indications are that it is starting to happen now. This still-nascent trend became clearer at the recent 2014

International Consumer Electronics Show (CES) in Las Vegas, which featured demonstration displays of some of the ways gesture recognition could bring big changes in how drivers interact with their cars.

For one, such technology might help stem the proliferation or even reduce the number of knobs and controls on automotive instrument panels and center consoles. And it could help avoid fumbling around to change a setting of a dashboard device and thus keep drivers' attention on the traffic outside.

CES demo

In a large tent pitched outside the CES convention halls, for example, **Visteon** demonstrated its Horizon cockpit concept, a simulator that provided a good indication of the power of “in-car Kinect” to manage an e-car's creature comforts and infotainment system.

When you sit in the demo's driver seat, you place your arm on the central armrest, which straight-away positions your hand within the system's sensory 3D envelope. You need not look at the display if you choose not to do so. Raise your palm into a “high-five” position with your fingers spread out, and the infrared camera on the Horizon console reads the gesture as the pre-programmed “system-activation” signal. The system immediately acknowledges that your message has been received with a vibration of the armrest and an audio signal.



Visteon's Horizon cockpit concept display at 2014 CES demoed true gesture-control features.

If you then speak “radio volume knob” (or similar keywords), the cockpit’s voice-recognition function causes the radio controls to pop up on the screen, ready for instructions. Simulate turning a real-world, physical volume control as you normally would with your fingers (or some circular motion) and the gesture system boosts or diminishes the speaker loudness as desired. It’s as easy as that.

Now say “temperature control” and the voice system activates the heating/cooling controls. Flatten out your palm to the horizontal and elevate your hand a bit, and the cabin heat rises. Lower your hand and the air flow cools off. You get the idea...

And so did the participants in the consumer clinics Visteon asked to try out the prototype technology, according to Shadi Mere, the company’s Innovation Manager. “Once you learn the gestures, which takes only a few seconds, it becomes second-nature,” he explained.

“The Horizon system captures in detail the spatial and kinematics of your hand,” Mere said. “It can biometrically distinguish your right hand from your left, the driver’s hand from the passenger’s, and so forth with up to 95% accuracy.”

By focusing on natural “gestural language” understanding and multiple modes of interaction (voice plus gestures), company engineers made operating the system highly intuitive, even to novice users, he said. “We kept it as simple as possible because we don’t want users to need a long learning curve.”

He said that Visteon’s software partner on the Horizon cockpit project was **Gestigon** of Lübeck, Germany.

“The consumer clinics were interesting,” the Visteon manager recalled. “We had expected that young people would embrace gesture technology more readily than the elder segment of the population” because the former were already familiar with it. “But that was not the case. It turned out that older people, who often have issues with the dexterity of their hands and can find it hard to grip a knob, really loved it,” he continued.

It turned out that some 70% of consumers who Visteon surveyed showed “strong interest” in having a “virtual volume knob” in their next vehicle. They felt that using such a feature was easier and more convenient than searching for a “traditional” volume knob and manipulating it.



The 2014 Cadillac XTS luxury sedan features GM’s pioneering CUE touch-less control system.

Representatives of carmakers who tried out the Horizon technology seemed to agree: “There was very high interest in the system from OEMs,” Mere noted.

Primed for growth

A market study that was conducted last year by market analysis firm **IHS Automotive** on trends in automotive human-machine interfaces (HMI) supports this observation. The report covered gesture-recognition technology as well as the simpler, less-costly, less-capable proximity sensing.

Automakers and brands including **Audi, BMW, Cadillac, Ford, General Motors, Hyundai, Kia, Lexus, Mercedes-Benz, Nissan, Toyota,** and **Volkswagen** are all working diligently to implement the new technology, said the lead author Mark Boyadjis, Senior Analyst & Manager for Infotainment & HMI at IHS. Within as little as five years, he expects that combined proximity and gesture-recognition system sales will exceed 14.5 million units worldwide, with an approximate penetration rate of 16% of vehicle sales. By 2023, these figures are expected to rise to more than 38 million unit sales and encompass nearly 40% of vehicle sales.

The list of potential Tier 1 and 2 auto suppliers that intend to produce products in this category is similarly long: **Continental, Delphi, Denso, H2i, Hamamatsu, Harman, Intersil, Johnson Controls, Melexis, Microsoft, Nippon Seiki, Osram Semiconductors, SoftKinetic, STMicrosystems, Pioneer, Preh, Seeing Machines, Texas Instruments, Tobii, Vishay, Visteon,** and **Yazaki.**

“Automotive gesture recognition is still a marketing buzzword right now,” Boyadjis stated, “but within a few years, it’s going to debut in luxury cars and then appear in the entire range of vehicles.”

He emphasized, however, that “it will supplement capacitive touchscreens, but it won’t replace them.” Automotive HMI designers will always use a multimodal approach to driver input, retaining many ways to interact with the system.

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Proximity controls rely on IR emitters and receivers to gauge time-of-flight to register 3D hand position.



A simple IR reflex camera can locate a driver's hand space using a LIDAR-type ranging method.

Boyadjis breaks the range of touch-free sensing technologies into three classes. The first generation will be of the basic proximity type, which use small, inexpensive infrared sensors with a range of a couple of inches to enable displays to wake from sleep modes when the sensor detects the presence of a hand or finger or to handle simple commands. He cited the Cadillac User Experience (CUE) system and the VW Golf's advanced HMI as early examples in mass-market production vehicles. In CUE, two infrared sensors that are sited just below the screen detect when a user's hand approaches the screen and activates frequently used menus.

"We expect a relatively quick uptake of this product," Boyadjis said. The 2014 Cadillac XTS luxury sedan and Chevrolet Corvette sports car feature a CUE7 system. Meanwhile, VW will make its proximity system standard on all Golf compact models starting in 2015, the IHS study stated.

Proximity sensors

At CES, Sevugan Nagappan, Marketing Manager for IR/Laser Products at Tier 2 supplier **Osram Opto Semiconductors**, which is based in Regensburg, Germany, showed *Automotive Engineering* one of his company's proximity sensors. "It's based on an infrared LED that features small size, the right power level, and high efficiency," he explained.

Nagappan said the time-of-flight (TOF) sensor is a form of light detection and ranging (LIDAR). It transmits a light pulse from the emitter to an object in its view. A receiver then determines the distance of the measured object by calculating the time it takes for the light pulse to travel from the emitter, reflect off the object, and return back to a light receiver in a pixel format. The TOF reflex camera modulates the LED pulses, placing a time stamp on each to triangulate the distance using time-domain concert, thus operating like a motion-capture system to detect how a person is moving.

"The high output is made possible by state-of-the-art thin-film chip technology and, combined with the small



Osram Opto Semiconductors makes infrared sensors that can enable automotive gesture-recognition controls.

package, opens up numerous new applications, particularly where there is very little available space but performance demands are high," he added. "If required, components can be packed very close together to increase the optical output with a high degree of flexibility." The result would be a multi-receiver matrix that "can interpret learned hand gestures such as left-right or right-left swipes."

Gesture recognition

Boyadjis categorized the matrix device as "second generation." "They typically have a bit longer range and monitor whole-hand gestures, such as 'swipe left,' 'swipe right,' but they are not going to see the number of fingers or other such details."

The third generation of the hand-sensing technology, in IHS's view, "would be high-resolution, multiband gesture-recognition systems, using stereo cameras for 3D depth perception." This kind of system will be able to distinguish between a single-finger swipe and a two-finger swipe, for instance.

The most common 3D-acquisition system that would be used in



Cadillac's CUE touch-less control system uses infrared sensors to interpret hand gestures.

third-generation implementations is stereoscopic vision, which uses dual cameras to obtain a left and right stereo image. The images are slightly offset to provide a parallax view. Another approach is structured light, which projects pattern on objects to measure or scan them.

"We expect third-generation gesture-recognition systems in luxury cars by 2017," Boyadjis said. He also cautioned that "there is such a thing as 'touch gesture recognition' with capacitive screens, but this is something entirely different" and accounts for some of the current confusion about the technology.



The Hyundai HCD-14 concept's Soft Connect gesture-recognition system picks up hand signals.

Remaining challenges

The biggest challenge for gesture recognition is false positives, he said. If the gesture command involves swiping left and a user inadvertently changes the radio track while grabbing their cup of coffee or motioning while speaking, then the error is not only frustrating for the driver, but highly distracting as well.

Lower-cost cars may need a conventional activation button on the steering wheel to reduce the chance of false positives, Boyadjis said.

Another major issue going forward is that the hand gestures themselves will have to be standardized. "Gesture recognition will not work if you have to learn the movements all over again when you buy a new car." ■

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