

Smart Touch® Sensing Places the Power of the Microprocessor at Your Fingertips

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ABSTRACT

Smart Touch® sensing is a breakthrough in human interface technology allowing direct access to computer power, such as with the highly successful iPhone™ and other handheld devices. By combining the reliability and flexibility of completely solid state sensing along with anthropometric considerations, capacitive sensing interface technology creates new automotive design opportunities.

Consumers are increasingly turning to touch screen devices for their ease of use. Touch screens enable designers to dramatically improve the automotive interior for (1) user satisfaction (2) OEM cost benefits (3) important safety/ergonomic benefits and (4) styling design freedom to harmonize with interior themes. Panels will not only act on touch, but will have functions that respond to hand gestures and movements. For example, a center stack console can be enabled to illuminate when the user makes a movement near it, with the added benefit of conserving power. Interfacing to a vehicle by capacitive sensing creates entirely new opportunities in the evolution of automotive interior design. The styling design possibilities are nearly endless providing freedoms that are unachievable with conventional switches.

This paper describes the design and operation of various systems that employ capacitive sensing technology. Also discussed are vehicle integration, ergonomic enhancements, and safety benefits associated with this technology.

APPROACH

Capacitive sensors have several noteworthy features not found in conventional switches such as those in the automotive center stack console shown in Figure 1. The most apparent difference in capacitive sensors is that they do not require force for activation. By utilizing materials like indium oxides, conductive polymers, or other evolving nanomaterials, capacitive sensors can be fabricated as optically transparent films. This results in capacitive sensors that are clear and thin enough to be placed in front of visual displays without noticeably degrading the optical clarity of the viewing area.



Fig. 1

Another key feature of capacitive sensors is that they can sense through relatively thick materials. Designers now have the option of integrating human interfaces into once unconventional locations such as the inside of trim panels, faceplates, moldings, and other such protective or ergonomic surfaces without disturbing the aesthetics of the finished product. Furthermore, capacitive sensors can form to complex contours and shapes providing virtually unlimited functional sensing geometries.

Applying capacitive sensors to a substrate in multiple or matrix configurations such as that shown in Figure 2 creates a versatile touch surface for human interface. Sensors activated by touch translate into coordinates that represent the points of human contact on the substrate surface. These contact points are processed by the control system into recognizable user input commands.

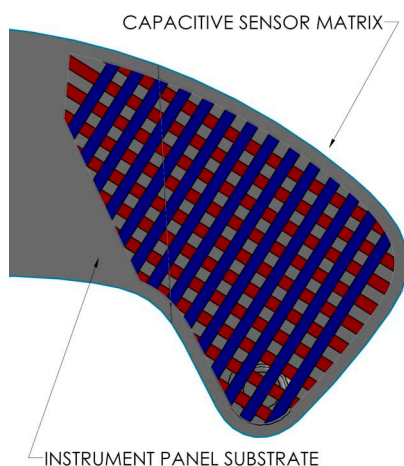


Fig. 2

Making the substrate and capacitive sensors largely translucent permits direct backlighting of the sensing areas. Backlighting can assist to locate the touch sensors and provide visual feedback of sensor activation.

In a more innovative approach, rear-projection technology can project light directly through the sensors to render images onto the surface of a substrate. When a sensor is activated, the image projected toward its position then corresponds to the users input request. If desired, sensor activation feedback can then be communicated through alteration of the projected image. Rear-projection offers the flexibility of displaying sharp images despite the complexity of a desired surface shape and contour. There are limitations in a rear-projection approach that must be taken into consideration by automotive interior designers:

1. Can enough light intensity be generated?
2. Heat build-up from the light source must be dissipated - This concern may be overcome by means such as air ventilation or the use of thermal electric devices.

As we move full speed into the information age automakers are constantly challenged by the consumer to provide vehicle features that will enhance their personal commuting experience and keep them connected to the world outside. As new features make their way into vehicles, the requirement is to provide a more logical and intuitive approach to managing the complexity of each human interface component.

APPLICATION

Visualize a vehicle interface system where display gages and indicators can be moved anywhere about the Instrument Panel (IP) or Center Stack Console (CSC). Likewise, input sensors can also be positioned most anywhere about the IP or CSC. The IP and CSC can then effectively be customized and set for the personal preferences of more than one driver. Expand the vision further by integrating the IP and CSC into a single contoured translucent substrate that flows around the steering column and down the center console area. Projectors illuminate the substrate from behind to create visual gages and indicators across the substrate surface. Likewise, the substrate is fabricated with multiple independent capacitive sensors as well as large areas of capacitive matrix sensors. Figure 3 shows a vehicle interior for application of capacitive touch sensors.