Technical Article

New Ways to Design and Implement User Interfaces in Dishwashers

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Dishwasher products have evolved from a luxury appliance into an essential kitchen appliance for most households. While dishwasher prices vary mainly because of their capacity and brand name, there are now additional features like stainless-steel finishes and capacitive touch interfaces.

Capacitive touch technology is changing how consumers operate dishwashers, and also motivating designers to innovate. Let’s look at how capacitive touch technology offers new ways to design and implement user interfaces and address the associated challenges.

Capacitive Touch through Metal

Many dishwashers have a metal finish, which looks both elegant and robust. Implementing human machine interfaces on metal surfaces is challenging, however, because it requires machining and cutting a hole to

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accommodate mechanical buttons. In addition to compromising design elegance, mechanical buttons are also prone to failure in moist, dusty or dirty conditions. Capacitive touch through metal enables touch designs that are waterproof, dust-proof, wear-resistant and highly immune to noise. Consumers have the flexibility to operate the dishwasher while wearing gloves, and the technology can detect both soft and hard touches.

Unlike the traditional capacitive touch approach, MSP430™ microcontrollers (MCUs) with CapTIvate™ technology use an alternate approach for touch-through-metal applications (see Figure 1). The stack up includes a printed circuit board (PCB) with traditional capacitive touch sensors and a spacer topped with a grounded metal overlay. This mechanical structure forms a variable capacitor that generates changes in value when consumers apply force to buttons, sliders or wheels. The integrated CapTIvate peripheral on MSP430 MCUs is sensitive enough to detect metal-plate deflections at the micron level.

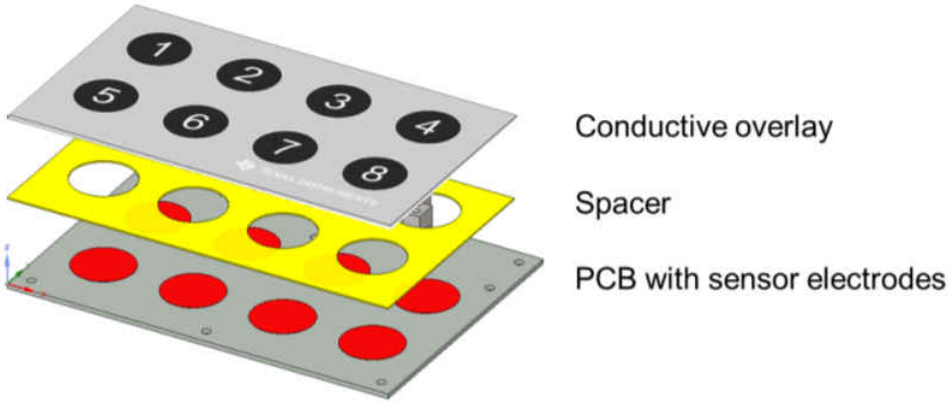

Figure 1. Stackup of Metal Touch

Temperature and Humidity Drift

Most modern dishwasher products have steam and dry features that could introduce temperature and humidity drift into the system. Capacitive sensing measurement results will also drift over time in response to environmental changes such as temperature and humidity. A change in temperature, humidity or both can appear to the system as a touch if not properly interpreted.

To ensure reliable operation, the CapTIvate software library handles slow drift in a sensor's measurement result caused by temperature or humidity in three ways:

- The long-term-average (LTA) tracks measurement drift associated with gradual environmental changes through a slow-moving infinite impulse response filter.
- The touch threshold varies proportionally with the LTA rather than as an absolute offset in order to maintain sensitivity.
- If runtime recalibration is enabled, the system will recalibrate if the LTA drifts outside of a window set above or below one-eighth of the specified conversion count, renormalizing the sensors to the specified conversion count.

These three methods work together to ensure that the system behaves as designed across its lifetime, even with temperature and humidity changes.

More than a Capacitive Touch Controller

Selecting a suitable MCU for a dishwasher user interface design is also critical because it could significantly shorten product development time, reduce overall system cost and save PCB space.

A suitable capacitive touch controller can manage many system functions in a dishwasher design: managing the backlight LED driver for the output user interface, communicating with other sensors in the system and monitoring the system status as well as providing self-diagnostics.

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	MSP430FR2512	MSP430FR2522	MSP430FR2632	MSP430FR2633	MSP430FR2675	MSP430FR2676
FRAM/RAM	8KB/2KB	8KB/2KB	8KB/2KB	16KB/4KB	32KB/6KB	64KB/8KB
Buttons (#)	Up to 4	Up to 16	Up to 16	Up to 64	Up to 64	Up to 64
Capacitive touch IOs	4	8	8	16	16	16
Sensing blocks	1	2	4	4	4	4
Package	16-pin TSSOP 20-pin QFN	16-pin TSSOP 20-pin QFN	24-pin VQFN and DSBGA	32-pin TSSOP and QFN 24-pin DSBGA	32- and 40-pin VQFN, 48-pin LQFP	32- and 40-pin VQFN, 48-pin LQFP

Figure 2. CapTIvate MCU Portfolio

Integrating all of these features with a single MCU requires more than a fixed-function or stand-alone capacitive touch controller. The MSP430 CapTIvate MCU family offers a wide portfolio of capacitive touch controllers (see Figure 2) that scale with your system integration requirements.

Additional Resources

- Learn more about MSP430 capacitive touch sensing microcontrollers.
- Learn more about CapTIvate technology in the "CapTIvate™ Technology Guide."
- Read these application reports:
- "Capacitive Touch Design Flow for MSP430 MCUs With CapTIvate Technology."
- "Capacitive Touch Through Metal Using MSP430 MCUs With CapTIvate Technology."

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