IPENTIV USE CASE

NFC Capacitive Sensing

Problem

Liquid waste and inaccurate measurements are chronic issues in the consumer, healthcare, and food and beverage industries. This leads to lost resources and profit for businesses and their customers. For industrial applications, it is difficult to measure fill level without opening the container, or to measure fill levels in containers that cannot be opened at all. The solution to help cut down on liquid waste and create a more seamless measuring process is an accurate sensor that is small and simple to use without any additional equipment.

Challenges in Capacitive Sensing

Liquid-level sensing based on capacitive sensors comes with its own challenges. It is like absolute capacitance sensing. Unlike touch detection, the absolute value of the liquid level needs to be measured. Environmental factors such as temperature and the presence of conductive objects can affect sensing accuracy. The common factors that impact liquid-level sensing include:

- **Temperature drift:** Temperature fluctuations during sensing operation have the most significant impact on performance.
- **Tank thickness:** The overlay thickness is considered as the insulating material between the sensor and the conducting material to be detected. Challenges can arise if the tank thickness is too high or the change in signal with liquid and without liquid is too small to detect.
- **Liquid viscosity:** Using capacitive sensing, liquids with low viscosity can be measured accurately.
- Liquid salt concentration: Salt concentration in the liquid affects sensing accuracy. The higher the salt concentration, the lower the sensing accuracy.
- **Conductive objects:** If a conductive object is close by, there is a higher chance of reporting the wrong result.
- Air gap between sensors and tank: As the air gap between the sensors and the tank increases, sensing accuracy decreases.

Our Solution: Identiv's Capacitive Fill Level Sensing Tag with NXP's NTAG[®] 22x DNA StatusDetect Chip Technology

According to a <u>report</u> by Market Research Future (MRFR), the global capacitive sensor market was valued at 27.03 bil-



lion in 2019 and the compound annual growth rate (CAGR) between 2020 and 2027 is predicted to be 5.2%. Near field communication (NFC)-enabled capacitive sensing technology benefits the demanded market by simply adding high-security to the solution.



Identiv's Capacitive Fill Level Sensing Tag is the first passive NFC-enabled capacitive sensing solution for fill measurement. Handled as a label, the tag is attached to an item, such as a liquid-filled container, and the level is sensed by capacitance. Users do not need an external sensor or special equipment for measurement. NXP's NTAG 22x DNA StatusDetect, connected to a capacitive structure in a label, makes it possible to read out capacity when interrogated with an NFC reader, such as a smartphone. It is the first and currently only commercial passive NFC-enabled capacitive sensing solution for fill-level measurement. NTAG 22x DNA StatusDetect ICs can be used as a passive sensor to detect a change in an item's environmental condition, such as moisture, pressure, or fill level. The change in capacitance, due to a change in electrical charge, is captured with an NFC reader and interpreted with a software application, i.e., if the change is outside preconfigured limits. This solution offers simple battery-free, maintenance-free sensing for a number of use cases. The tag IC products are available with 144 and 208 bytes of memory, and memory protection is based on a password or mutual (two-way) authentication.

Benefits of Capacitive Fill Level Sensing Tags

Capacitive Fill Level Sensing Tags are anticipated to produce significant cost and resource savings for consumers and companies. These sensing tags provide a smart, simple, and single-use solution to monitor fill levels. As there is no need to attach an expensive or complicated sensor or battery to monitor liquid levels, these tags help businesses cut down on unnecessary costs and time.

Due to the built-in SUN (Secure Unique NFC) functionality, using a dynamic message authentication code (CMAC) based on AES cryptography, the authenticity of tagged products can be verified, as well as the integrity of the capacitive measurement values, which correspond to the fill level. Businesses can use their resources more efficiently, and in healthcare use cases, patients will be provided with valid measurements for injectable liquid-based medications.

Compared to competitors' products, this tag is NFC-enabled and is simple and intuitive to use: just tap to see the fill level. It is flexible in usage and can attach to convex or concave surfaces. It does not require an external sensor or battery.

Top Use Cases

NFC capacitive sensing can be used for a number of applications.

Fill Level Sensing

It can be used to check cartridges, bottles, or any other kind of liquid-filled consumable/container. Capacitive sensing can also be used to check if syringes/autoinjectors have been properly administered in clinical trials, patient compliance, and telemedicine applications.



Skin Condition Monitoring

These tags can also be used in cosmetics and healthcare applications. By attaching the patch to the skin and reading the capacitive measurement with an NFC-enabled smartphone, various skin conditions can be differentiated and monitored.

Optional iontophoresis functionality can be added with a printed battery, which can improve the efficacy of agents through the skin barrier. In addition, it allows for monitoring and logging skin conditions over time, proving its efficacy.

NFC-Enabled Wound Care

This application is part of a publicly funded project, WiPowSense. The goal is to develop a smart NFC-enabled wound care solution to monitor wound gas and humidity. With NXP's sophisticated NTAG SmartSensor technology, anyone can sense the healing of a wound through the level of moisture without physically opening the dressing using NFC connectivity via smartphone.

Opening Detection

It can be used to check if bottles or other types of packaging are open or closed without having to destroy a conductive "tamper loop". Capacitive opening detection is especially suited for bottle closures or form factors physically integrated into products.

Wet/Dry Sensing

Sense wetness or dryness without liquid contact, such as in car trunks, on diapers, etc.

Moisture Detection

It can be used to <u>detect moisture in wooden houses</u> and in <u>concrete drying supervision</u>. Identiv's NFC-enabled smart sensing tag easily detects moisture in wooden houses or drying concrete, saving time and money. The eco-friendly NFC solution is also batteryless, meaning it produces absolutely no e-waste.

Whether regulating dosage in an insulin pump or determining when to order a refill of a beauty care product, NFC tags with status detection and sensing capabilities improve product convenience, safety, and everyday life.





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Find out more about Identiv's RFID, NFC, and inlay portfolio:

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