Whitepaper

Noise Suppression Solution from MicroTouch™ Improves Touchscreen Performance in Presence of Water

The presence of moisture on a touchscreen can significantly inhibit its functionality. Even simple tasks, such as unlocking a smartphone with sweaty fingers after a run, using an outdoor ATM machine in the rain, or operating a boat navigation system that has been sprayed with saltwater, can be made difficult or unmanageable.

Modern touchscreens function through capacitive touch technology, which responds to the electrical properties of the human body.

Projective capacitive touchscreens (sensors) are comprised of a glass top layer, followed by an array of X electrodes, an insulator, then an array of Y electrodes. The electrodes, generally made from a transparent conductive material called Indium Tin Oxide (ITO), form a matrix of capacitors where the X and Y arrays intersect (Figure 3). Voltage pulses are driven on the X rows by a touchscreen controller and received by the Y columns. Charge is transferred by electric field from the capacitors formed by the intersecting X and Y electrodes. The received signals on the Y columns return to the touchscreen controller where the received charge is measured as a voltage drop.

When a finger touches a touch sensor, some of the electrical charge is diverted capacitively from the driven electrodes to the finger, giving the charge another path. This change in electron flow takes a small percentage of the charge that would otherwise be picked up by the receive electrodes. This small change in capacitance results in a measurable change on the receive electrodes at the touch controller. The touch controller can calculate the touch location from these small changes in capacitance.

Problems can arise because water may conduct electricity or capacitively couple to the electrodes, causing a touchscreen to respond like a touch from a finger.

Small amounts of water – in the form of sweat, condensation, or any other visible moisture - on a touchscreen can disrupt the electric fields formed between he electrodes and fingers to reduce the touch controller's ability to accurately detect touch. This significantly inhibits its function, requiring users to repeat actions or even triggering unintended functions.

Problem

False and ghost touches are often caused by water affecting the touch controller's ability to accurately report touch coordinates.

Ghost touches occur without the presence of a finger. An example would be rain drops hitting your touchscreen and touches are erroneously registered.

False touches are when the location of your touch is inaccurately reported. This can be most easily observed when you run your finger across a wet screen and the see the reported position deviate from the true position.

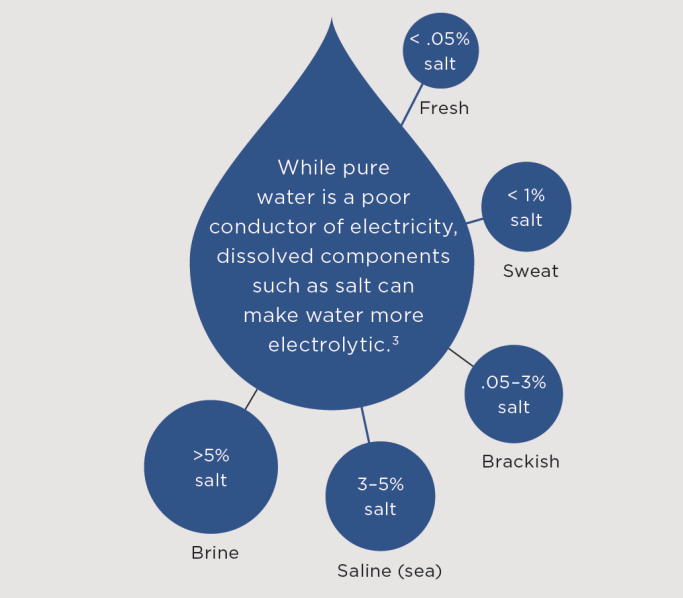
Other common water related touch problems are:

- Line draw on wet screen – breaks in line. Touch is intermittently lost even though finger is contacting the touch screen
- Line draw on wet screen – touches continue to be logged in previous locations after the finger's touch position has changed. Sometimes touches continue to be reported after the finger is lifted from the touchscreen.
- Two finger line draw on wet screen – Lines cross. Touch controller is unable to distinguish between the two fingers
- Touch on wet screen – Touch is not reported.

These issues are compounded when the water (or any fluid) is highly conductive. The more conductive a liquid is, the easier it is for charge to take an unintended path, thus leading to erroneous position reports. Pure water is not conductive, however in the real word water has impurities which make it conductive. Rain water generally has the lower conductivity. Bottled water varies – it depends on the source of the water. Tap water varies but is usually more conductive due to the influence of metal pipes.

Sweat is the higher than tap water. Salt water is the highest (Figure 1). Current touchscreen technologies work to combat false and ghost touches from liquids with high electrolytic properties by simply suppressing touch altogether. The intent is to shut down all functions rather than allowing the activation of unintended functions. This is why the presence of water on standard touchscreens, depending on the individual device, results in many false or ghost touches or cessation of response to touch.

(Figure 1)



Rationale

As touchscreens continue to normalize in our day-to-day routines - whether your using a point-of-sale system, self check-out kiosk, point-of-information tablet, it is necessary to enhance their usability in scenarios where they may come into contact with water.

Through a combination of the right hardware along with extensive amounts of tuning - MicroTouch™ has tools and product to reduce the over occurrence of false touches due to water being present. MicroTouch™ has developed a system to significantly reduce the occurrence of false and ghost touches when water is present, greatly increasing touchscreen usability in the presence of fluids.

Case Study

A comparison was done between MicroTouch™ optimized water solution verses a competitor's water solution (Figure 2).

A variety of tests were performed with tap water, a 1% salt solution, and a 5% solution. Tests included:

- Water spray on dry touchscreen
- Wet finger draw (one and two finger) on dry screen
- Line draw on wet touch screen (one and two fingers)

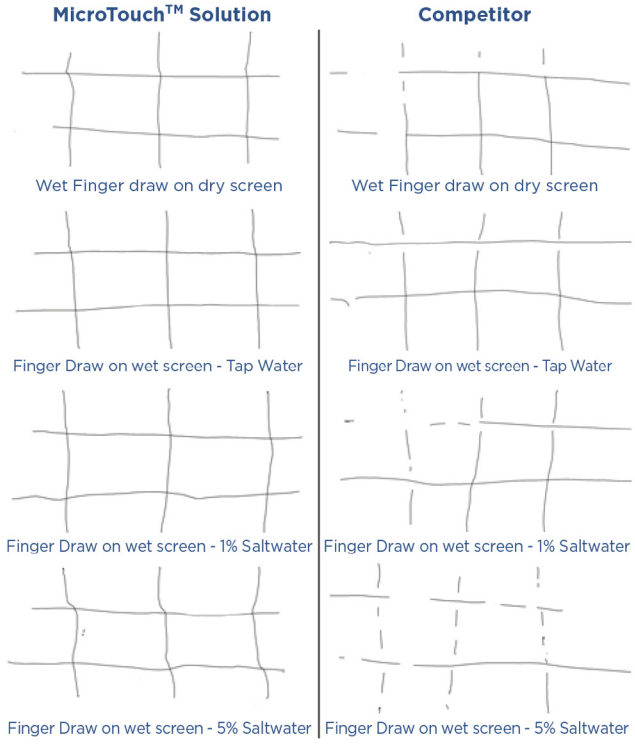
Conclusion

MicroTouch™ has developed a solution to improve touch performance in the presence of water above many of the available solutions currently available. Test data shows MicroTouch™ solution rejects false touches while maintaining accuracy without line breaks. The touchscreen maintains normal functionality with up to a 5% salt solution. These attributes make the MicroTouch™ system suitable for use in any situation where moisture may be present, even on the open seas or in a fitness scenario where touchscreens were previously not reliable.

Bibliography:

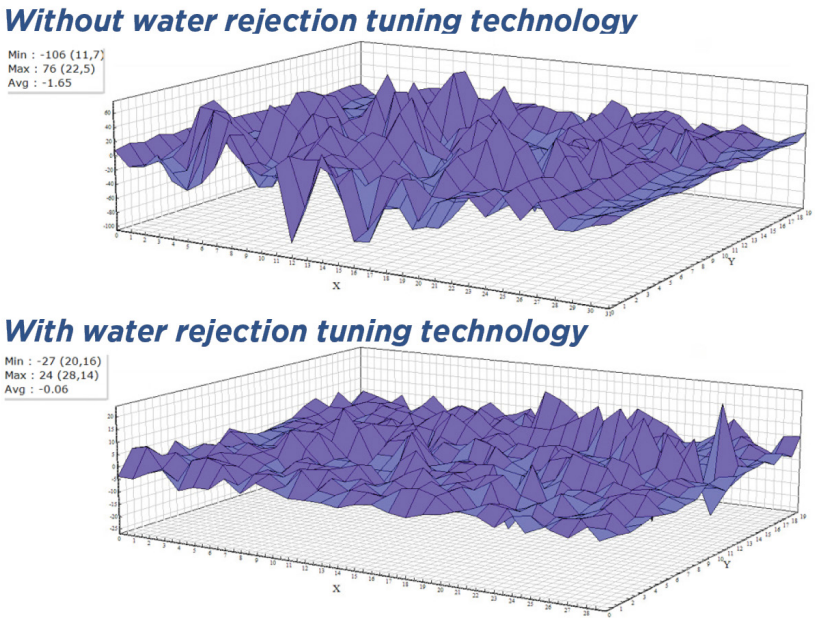
- Karin Heineman, "Here's why even one drop of water confuses your smartphone screen," Business Insider, last modified April 1, 2016, https://www.businessinsider.com/why-water-confuses-smartphone-screen-inside-science-2016-4
- Kannan Srinivasagam, Vibheesh B., "Differentiating Noise from Real Touch – The Key to Robust Capacitive Sensing," Cypress, last modified April 15, 2011, https://www.cypress.com/documentation/technical-articles/differentiating-noise-real-touch-key-robust-capacitive-sensing
- "Electrical Conductivity of Water," U.S. Department of the Interior, last

Results (Figure 2)



The results of the experiment show MicroTouch™ water tuned touchscreen performed better than the competitor's solution. MicroTouch™ solution was more frequently able to reject false touches and more accurately report positions without line breaks in the presence of water.

(Figure 3)



With the water rejection-tuning method, noise level was effectively suppressed by 300-400% overall.

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