Time for a change: This diaper alerts caregiver when it is wet

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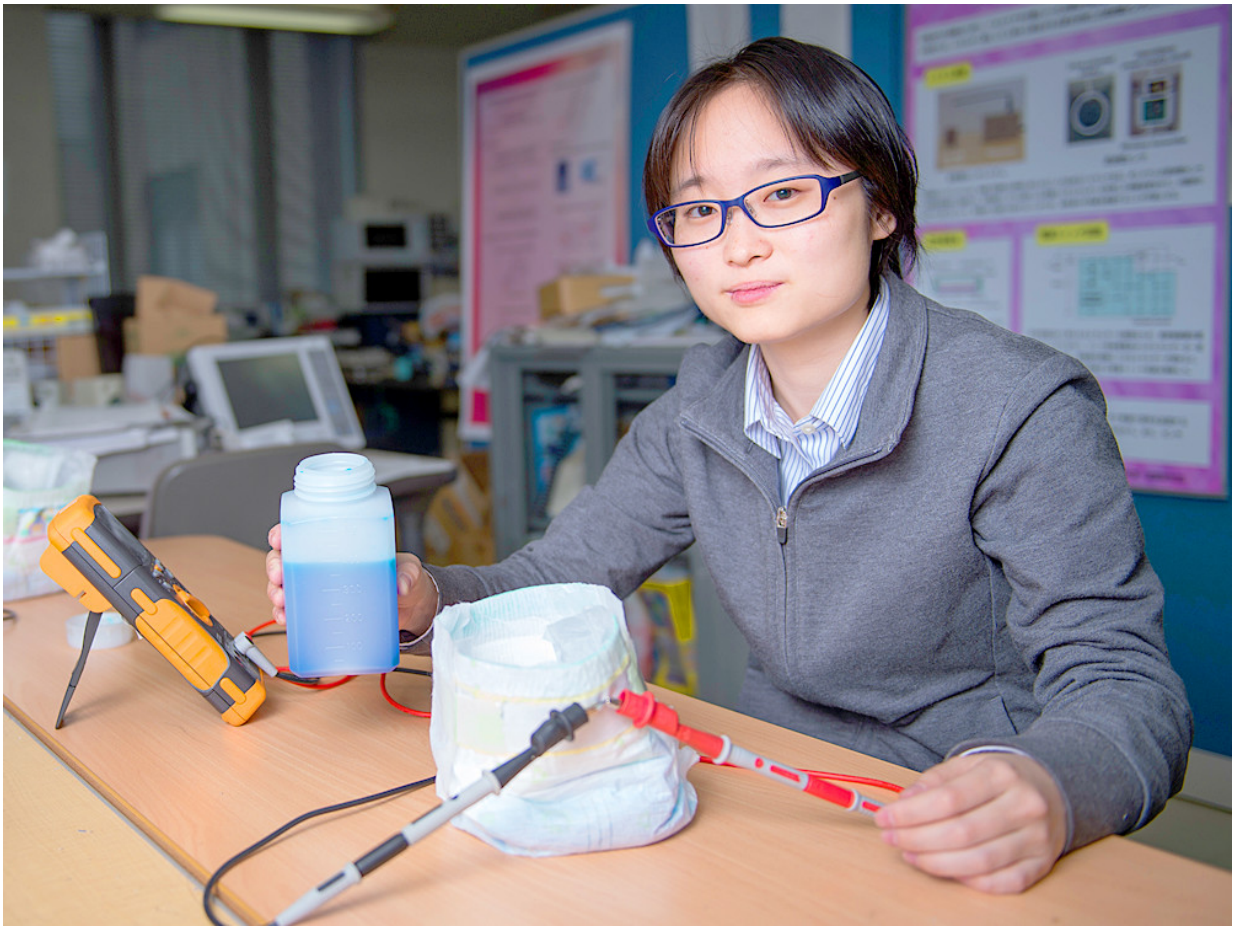

Credit: Ritsumeikan University

(Tech Xplore)—University researchers have been focusing on

developing a smart diaper that tells you when it's wet and uses its urine content as power to relay the message. You can thank researchers at Ritsumeikan University in Japan for this idea.

There are electrolytes within our urine and Ryan Mandelbaum in *Gizmodo* said that "I would assume the urine acts as the electrolyte allowing current to flow between either of the two electrodes."

The diaper is not intended for babies but for those who must care for aging patients who cope with urinary incontinence. Japan's aging population is addressed here; Japan observers at times refer to the situation as a "super-aging" or "hyper aged" society.

New Delhi Times, looking at Japan's aging population, said earlier this month that "almost 25 percent of its population are over the age 65, by 2040 the ratio is expected to rise to 36 percent."

The development of diapers for elderly people which can alert their caregivers that the diapers are wet addresses this. According to *Nikkei Technology Online*, "The university expects that it will be used at nursing facilities that care patients of urinary incontinence."

Urine generates the electricity. The current of electricity generated by the system increases as the amount of input urine increases, said *Nikkei Technology Online*.

A key element to all this is a wireless self-powered urinary-incontinence sensor. There is an intermittent-power-supply circuit with a 0.3 V start-up converter, and a wireless transmitter. The electricity that is generated is stored in a capacitor in the sensor. When the amount of urine reaches a certain level, the system transmits wireless signals.

Mayuko Uno, *Nikkei Technology Online*, said, "The amount of urine

stored in the diaper is estimated from the interval of signal reception, and the user is notified of the optimal timing of replacing a diaper."

Is this safe to wear? The battery consists of absorbent material sandwiched between an aluminum electrode and spongiform carbon electrode.

They prepared a research paper on their work, "Wearable Self-Powered Diaper-Shaped Urinary-Incontinence Sensor Suppressing Response-Time Variation With 0.3 V Start-Up Converter."

Their work was published in the *IEEE Sensors Journal* earlier this year. Results: "When 80 cm3 of urine is poured onto a diaper, the sensor transmits an ID signal over a distance of 5 m. The response time of the sensor is 17 s, and the period of intermittent operation is 12-s long."

The three authors are from the department of electronic and computer engineering at the university. They are Ami Tanaka, Fumiyasu Utsunomiya and Takakuni Douseki. *Nikkei Technology Online* said the system was developed by Douseki.

In addition to the paper, a demonstration for the media took place. Uno reported that for the demo, "a commercially available paper diaper for infants was modified. It contains (1) activated carbon that is 320mm in length and 5mm in width and (2) an aluminum electrode whose width is 1.8mm between absorbent and a waterproof sheet."

According to the university web site, "it should only take a little longer to make this a real commercial product."

Last year, there was a report about a urinal installed at the University of the West of England to demonstrate how urine can generate electricity. "The university partnered with Oxfam to work on a way to bring

electricity to refugee camps in disaster areas," said *Digital Trends*.

More information: Ami Tanaka et al, Wearable Self-Powered Diaper-Shaped Urinary-Incontinence Sensor Suppressing Response-Time Variation With 0.3 V Start-Up Converter, *IEEE Sensors Journal* (2016). DOI: 10.1109/JSEN.2015.2483900

Abstract

A wearable, wireless self-powered urinary-incontinence sensor has been developed that consists of a diaper-shaped urine-activated battery, an intermittent-power-supply circuit with a 0.3 V start-up converter, and a wireless transmitter. The battery is embedded in a diaper and consists of absorbent material sandwiched between an aluminum electrode and a spongiform carbon electrode, which are safe to wear. The intermittent-power-supply circuit with the start-up converter makes it possible to boost the 0.6 V output of the battery to 2 V. The boosting operation reduces the variation in the charging time of the storage capacitor among batteries, thereby reducing the variation in the delay time of the intermittent-power-supply circuit, which contains the storage capacitor. A design method for determining both the optimum input-voltage range, in which the variation in charging time is small, and also the capacitance of the storage capacitor is also described. A prototype urinary-incontinence sensor was fabricated to verify the effectiveness of our sensor. When 80 cm3 of urine is poured onto a diaper, the sensor transmits an ID signal over a distance of 5 m. The response time of the sensor is 17 s, and the period of intermittent operation is 12-s long.