INNOVATION ARTICLES
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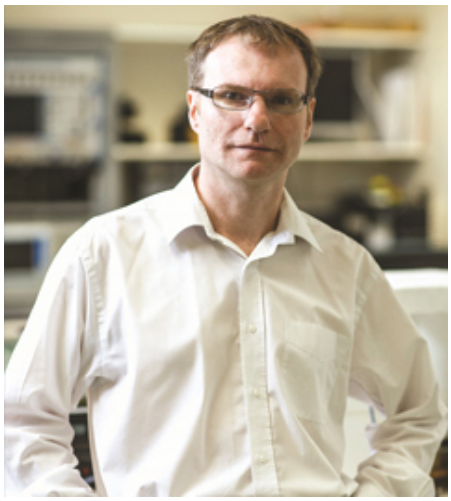

RADIOFREQUENCY TEMPORARY TATTOOS: HIDING SENSORS IN PLAIN SIGHT

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A team from the University of Kent, UK, are developing sticking plasters or "temporary tattoos„ with radiofrequency identification (RFID) technology. This can be used to monitor patient vital signs, transmitting the data to a recorder in the patients home.

Around 10 years ago, communications engineer Prof. John Batchelor, School of Engineering at the University of Kent, was researching how to use RFID tags in assets tracking, like tracking a parcel through a warehouse

cages or glass bottles, he started casting around for a new challenge. “I thought, surely there’s nothing more difficult than making them work on people,„ says Batchelor. This question led Batchelor into the world of medtech and his present research on using wearable RFID sensors for a myriad of applications.

RFID tags are easy to disguise as simple labels, sticking plasters or even transfer tattoos, according to Batchelor. “It’s a paper or a plastic label with a bit of metal antenna, and a tiny integrated circuit. There’s no battery and no electronics,„ he says. The RFID technology used by the team is ultra-high frequency (UHF) and can work over a few metres. “You have a reader on your wall, or in your home, which sends a radiowave to the tag [on your skin],„ explains Batchelor, “The received radio waves provide the energy to turn the tag on. Then the tag flashes the information back to the reader.„ For the first prototype, a colleague painted conductive paint on a piece of plastic tape, stuck the tape on Batchelor’s skin and peeled the tape away, leaving the paint “tattooed„ on his skin. The resulting RFID tattoo could be detected from up to one metre away.

One application of the RFID tattoos is sensing vital functions. “The beauty of these tattoos is that you put them on, forget about them, and wear them for at least a week. They’ll survive things like exercise and showers. That makes them suitable for things like surface skin temperature, electrocardiogram, electromyography and movement sensing such as gait analysis,„ says Batchelor. Another application is sweat testing. “When you’ve got a skin based sensor, sweat the most obvious thing to look at,„ says Batchelor. Sweat levels can useful in measuring stress and anxiety over a period of time to help track patterns. This could help pinpoint the triggers for stress, for example in autistic children. At first glance, similar devices seem to exist, but as Batchelor explains “these devices are addressing the biochemistry side of things but they are really just electrodes that are connected to something like a little mobile phone. There’s usually a strapped on little box of electronics too.„ The Kent team want to do away with this little box of electronics. They also want to banish batteries, which make devices thicker and heavier, and of course need charging. “At the moment we don’t have systems you can wear for a week and just forget about because there’ll either be a wristband, or a battery to recharge or wires you have to remember to plug in,„ says Batchelor. The trick to avoiding batteries is to reduce the electronic complexity of the tag as much as possible. “We do put microprocessors on some of the tattoos but it’s still powered from its received signal,„ says Batchelor, adding that the wearer might need to be closer to the reader to receive enough radio wave energy to wake up the RFID tattoo. “For electrochemistry sensing, you might also need a microprocessor because it is inherently current based sensing. We’re also interested in materials that generate their own voltage potential, like piezoelectric crystal materials that, when distorted mechanically, produce a voltage across them. If you put these materials in a tag, then distort the tag by bending a limb for example, you produce a voltage with very simple electronics.„

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John Batchelor

Another research direction is location sensing. Batchelor's team is currently collaborating with six other universities to try and understand why nearly half of assistive devices, from walking canes to prosthetic limbs, are abandoned by patients. The idea is to set up an RFID reader in the patients house and to apply RFID tattoos to both the patient and their device. The system can track and report the use of the device. "They can pull out a profile of how much people are using or engaging with their equipment,„ explains Batchelor, "You can also send appropriate feedback to the user.„

Collaborating with the material scientists, IT specialists and clinicians is challenging, but "absolutely essential,„ according to Batchelor. "Medtech is the field where you have to engage other stakeholders right from the start. The clinicians and end-users have to be inputting throughout the process.„ And the challenges of interdisciplinary working go deeper than a simple difference of vocabulary. "Languages are different, timescales are different and that's massively challenging. But we all get on and it's been an eye-opener for me. When you start collaborating across disciplines, it's like the horizons broaden out before you and you see so many things you can do.„