Psychosensory electronic skin technology for future AI and humanoid development

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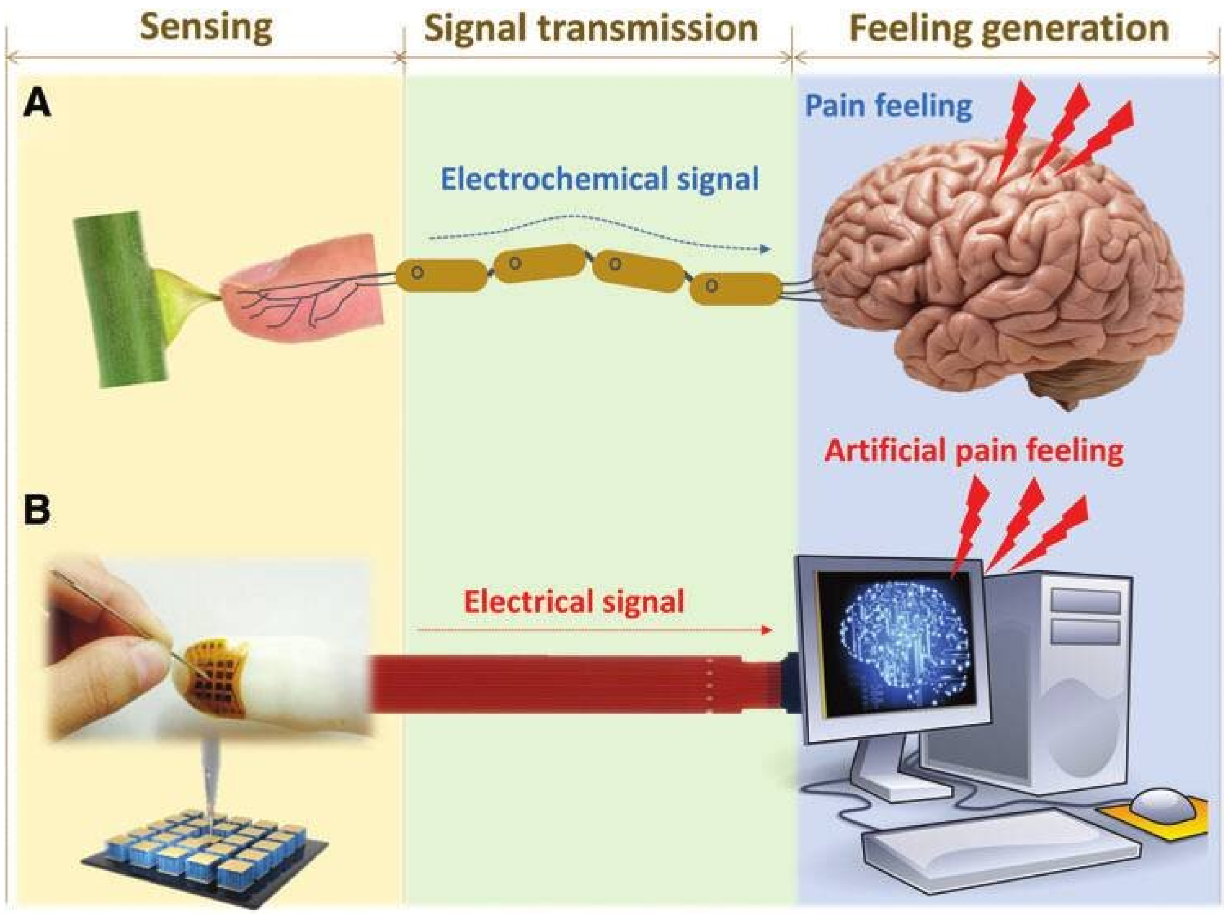

A mimetic diagram of artificial pain generation based on signal processing through a sense of touch. Credit: DGIST

Professor Jae Eun Jang's team in the Department of Information and

Communication Engineering has developed electronic skin technology that can detect "prick" and "hot" pain sensations like humans. This research result has applications in the development of humanoid robots and prosthetic hands in the future.

Scientists are continuously performing research to imitate tactile, olfactory and palate senses, and tactile sensing is expected to be the next mimetic technology for various applications. Currently, most tactile sensor research is focused on physical mimetic technologies that measure the pressure used for a robot to grab an object, but psychosensory tactile research on mimicking human tactile sensory responses like those caused by soft, smooth or rough surfaces has a long way to go.

Professor Jae Eun Jang's team has developed a tactile sensor that can feel pain and temperature like humans through a joint project with Professor Cheil Moon's team in the Department of Brain and Cognitive Science, Professor Ji-woong Choi's team in the Department of Information and Communication Engineering, and Professor Hongsoo Choi's team in the Department of Robotics Engineering. Its key strengths are that it has simplified the sensor structure and can measure pressure and temperature at the same time. Furthermore, it can be applied on various tactile systems regardless of the measurement principle of the sensor.

The research team focused on zinc oxide (ZnO) nanowire technology. The device is a self-powered tactile sensor that does not need a battery thanks to its piezoelectric effect, which generates electrical signals by detecting pressure. A temperature sensor using Seebeck effect allows one sensor to do two jobs. The research team arranged electrodes on a polyimide flexible substrate, grew the ZnO nanowire, and could measure the piezoelectric effect by pressure and the Seebeck effect by temperature change at the same time. The research team also succeeded in developing a signal processing technique that judges the generation of pain signals considering the pressure level, stimulated area and temperature.

Professor Jang in the Department of Information and Communication Engineering said, "We have developed a core base technology that can effectively detect pain, which is necessary for developing future-type tactile sensors. It will be widely applied on electronic skin that feels various senses, as well as new human-machine interactions. If robots can also feel pain, our research will expand further into technology to control robots' aggressive tendency, which is one of the risk factors of AI development."

More information: Minkyung Sim et al. Electronic Skin to Feel "Pain": Detecting "Prick" and "Hot" Pain Sensations, *Soft Robotics* (2019). DOI: 10.1089/soro.2018.0049

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