Skin hardness to estimate better human thermal status

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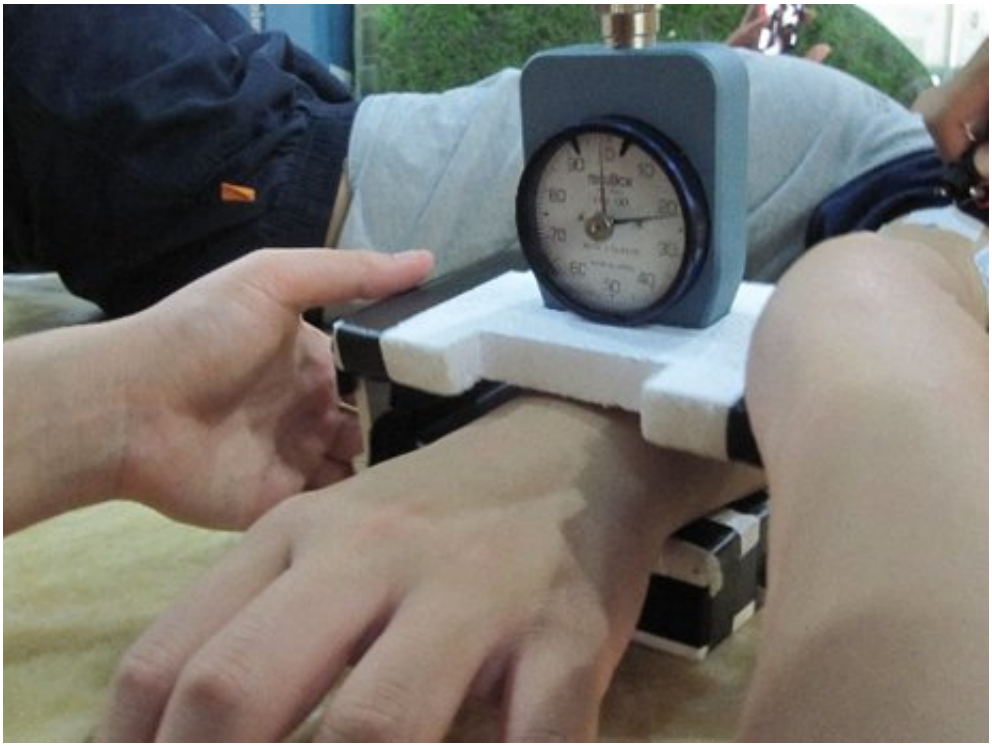

Figure 1. Measuring human thermal status through skin hardness. Credit: The Korea Advanced Institute of Science and Technology (KAIST)

Under the same temperature and humidity, human thermal status may vary due to individual body constitution and climatic environment. A KAIST research team previously developed a wearable sweat rate sensor for human thermal comfort monitoring. Furthering the development, this time they proposed skin hardness as an additional, independent

physiological sign to estimate human thermal status more accurately. This novel approach can be applied to developing systems incorporating human-machine interaction, which requires accurate information about human thermal status.

Professor Young-Ho Cho and his team from the Department of Bio and Brain Engineering had previously studied skin temperature and sweat rate to determine human thermal comfort, and developed a watch-type sweat rate sensor that accurately and steadily detects thermal comfort last February (title: Wearable Sweat Rate Sensors for Human Thermal Comfort Monitoring).

However, skin temperature and sweat rate are still not enough to estimate exact human thermal comfort. Hence, an additional indicator is required for enhancing the accuracy and reliability of the estimation and the team selected skin hardness. When people feel hot or cold, arrector pili muscles connected to hair follicles contract and expand, and skin hardness comes from this contraction and relaxation of the muscles. Based on the phenomenon of changing skin hardness, the team proposed skin hardness as a new indicator for measuring human thermal sensation.

With this new estimation model using three physiological signs for estimating human thermal status, the team conducted human experiments and verified that skin hardness is effective and independent from the two conventional physiological signs. Adding skin hardness to the conventional model can reduce errors by 23.5%, which makes its estimation more reliable.

Figure 2. The instrument used for measuring human thermal status through skin hardness. Credit: The Korea Advanced Institute of Science and Technology (KAIST)

The team will develop a sensor that detects skin hardness and applies it to cognitive air-conditioning and heating systems that better interact with humans than existing systems.

Professor Cho said, "Introducing this new indicator, skin hardness, elevates the reliability of measuring human thermal comfort regardless of individual body constitution and climatic environment. Based on this method, we can develop a personalized air conditioning and heating system that will allow affective interaction between humans and machines by sharing both physical and mental health conditions and

emotions."

More information: Sunghyun Yoon et al. Evaluation of Skin Hardness as a Physiological Sign of Human Thermal Status, *Scientific Reports* (2018). DOI: 10.1038/s41598-018-30206-1

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