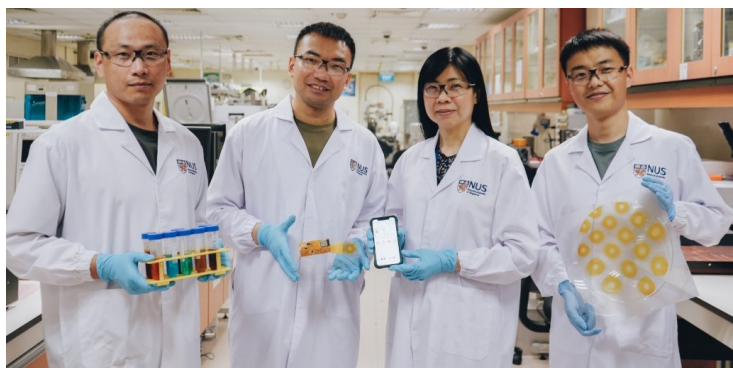


Singapore designs smart sensor to decode fatigue and stress from body signals on the move

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A soft, skin-conforming hydrogel paired with AI-driven signal processing



About one in three employees in Singapore report feeling burnt out — one of the highest rates globally. Burnout and chronic fatigue carry a substantial economic cost and pose serious risks in professions where alertness is critical.

Wearable devices could fill the gap by continuously tracking cardiovascular markers linked to the autonomic nervous system, but their readings degrade sharply during everyday movement.

A research team from the Department of Electrical and Computer Engineering under the College of Design and Engineering at the National University of Singapore has developed a metahydrogel platform integrated with AI-driven signal processing that suppresses multiple sources of motion noise simultaneously.

Motion artefacts from muscle activity, body movement and physiological interference overwhelm the faint heart and blood pressure signals these devices are trying to capture, and current mitigation strategies typically address only one type of noise or a narrow frequency band.

The system delivers an electrocardiograph (ECG) signal-to-noise ratio (SNR) of 37.36 dB and blood pressure deviation as low as 3 mmHg during movement — accuracy that meets ISO clinical-grade standards and outperforms commercial trackers currently available in the market. Combined with machine learning, the platform classifies fatigue levels with 92 per cent accuracy, pointing towards objective, continuous mental health monitoring in real-world settings.

The team spent about four years developing the underlying sensing technologies before arriving at the metahydrogel concept about two and a half years ago.

On the industry side, the team is seeking partners to improve device consistency and scalability. “Our current material synthesis and system fabrication are still largely based on laboratory processes. We aim to collaborate with industrial partners to optimise manufacturing strategies and advance the platform toward practical, product-level implementation,” said the researchers.