Machine Learning Classification Method to Detect Autonomic Dysreflexia

Smartwatch-integrated multimodal sensing system that identifies spinal cord injury complications with >93% accuracy.

Researchers at Purdue University have developed a system of sensors and a controller device that can detect autonomic dysreflexia non-invasively. Autonomic dysreflexia (AD) is a unique manifestation in individuals with spinal cord injury (SCI) resulting from sympathetic hyperactivation. AD is caused by noxious stimuli occurring below the level of injury, which the affected individual cannot perceive due to paralysis. Clinically, medical professionals use blood pressure monitoring to diagnose AD. However, this method is impractical for continuous monitoring, as it restricts individuals' activities and can be affected by movements such as wheeling or transferring. The researchers' system can distinguish the unique signatures of AD from different sympathetic stressors, and it uses machine learning models to automate the process. The system can measure ECG, skin nerve activity, galvanic skin response, and skin temperature of the user, extract features from the measurements, and classify the features to identify the onset of AD using the machine learning model. Upon detection of AD, the device can notify the subject, their caregiver, or their medical professional. The system can be integrated with a smartwatch for signal detection and message output.

Technology Validation: In a test with rodents with SCI, AD was rapidly detected with 93.4% accuracy. In humans with chronic SCI, AD symptoms were confirmed with 94.1% accuracy.

Related Publications: Shruthi Suresh, Thomas H. Everett IV, Riyi Shi, and Bradley S. Duerstock. Automatic Detection and Characterization of Autonomic Dysreflexia Using Multi-Modal Non-Invasive Sensing and Neural Networks, Neurotrauma Reports 2022 3:1, 501-510.

Suresh S, Newton DT, Everett TH IV, Lin G and Duerstock BS (2022) Feature Selection Techniques for a Machine Learning Model to Detect Autonomic

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Dysreflexia. Front. Neuroinform. 16:901428. doi: 10.3389/fninf.2022.901428

Suresh, S. and Duerstock, B.S. (2020) Automated Detection of Symptomatic Autonomic Dysreflexia through Multimodal Sensing. IEEE Journal of Translational Engineering in Health and Medicine, 8, 1-8. DOI: 10.1109/JTEHM.2019.2955947

Advantages

- Sensitive

- Noninvasive

- Automated

- Can be integrated with a smartwatch

- Point of care technology

Applications

- Automatic and noninvasive detection of autonomic dysreflexia

TRL: 3

Intellectual Property:

Provisional-Patent, 2022-08-10, United States

Utility-Gov. Funding, 2023-08-10, United States

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