INNOVATION PARTNERSHIPS
UNIVERSITY OF MICHIGAN

An Approach to Non-Invasively Measure Dehydration Status using Physiological Data

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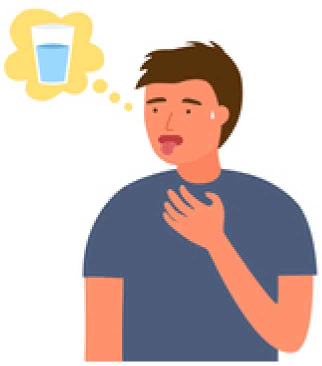

OVERVIEW

A non-invasive method to monitor dehydration status

- Measures heart rate time series during characteristic postural changes
- Provides a linear model to define dehydration as a binary value

BACKGROUND

Regulation of the hydration status is vital for human health. The typical water content in a human body varies from 55% to 75% of body weight, with a ratio of intracellular to extracellular water of about 2 to 1. Reduced water content can create serious health problems, especially among children and in the elderly. Fluid balance is important in healthcare settings when dehydration can result from diarrhea, vomiting, or fever. Alternatively, dehydration can become dangerous during periods of strenuous exercise due to excessive sweating, especially in hot and humid conditions. The standard evaluative measures for dehydration include serum tests for electrolytes and renal function or urinalysis. A less specific measure of dehydration involves pinching an area of skin on the back of the hand, lifting it up, and observing if it does not return to a normal architecture upon its release. A need exists for a non-invasive yet accurate measure of dehydration, especially outside of hospital settings where diagnostic tests are not available.

INNOVATION

Researchers have developed a method to non-invasively monitor dehydration status. The approach measures an individual's heart rate time series during characteristic postural changes (e.g., toe touches) captured using an inertial measurement unit. From the postural information, the measure calculates the absolute difference between the mean pitch value of the individual

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before and after the postural transition. From the heart rate signals, one can calculate over 700 features from each of the two segments of heart rate (pre and post transition), including features such as fast Fourier transform (FFT) coefficients, standard statistical descriptors (mean, median, max, etc.), energy information, and linearity coefficients. The methodology is to then concatenate the feature vectors from each segment of heart rate, resulting in a total of 1035 features, after discarding all features with undefined values. Using data labeled with ground truth dehydration status, investigators can train a linear model to map these features to dehydration status as a binary value. Additional validation of this approach can fine tune the process of calculating dehydration via contemporary sensors.