Poster: HydraSense: Personalized Hydration Monitoring with Wearables and Machine Learning

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***Abstract*—Dehydration affects many people worldwide and it can have severe consequences if remains unaddressed. A continuous hydration monitoring and reminder system based on wearable sensors and machine learning can ensure adequate fluid intake to prevent unwanted outcomes and to increase productivity. Despite the increasing popularity of wearable systems and smartphones, an affordable wearable-based hydration monitoring system that also considers environmental parameters for just-in-time decisions is not available. Our proposed system, HydraSense, devises a machine learning solution for detecting the activity, the surrounding environment, and the current level of hydration. By considering the activity and environmental parameters, HydraSense evaluates the adjusted fluid intake requirement and recommends a suitable action based on the severity of the dehydration. Additionally, we investigate the relationships of human activities and postures with dehydration. We are currently collecting and analyzing data for the evaluation of the proposed system.**

***Index Terms*—machine learning, hydration, body sensor networks**

I. Introduction

Researchers and clinicians agree that a large number of U.S. adults are chronically dehydrated [1]. Dehydration can cause fatigue, dizziness, and even loss of consciousness. The dehydration tests are often carried out with blood or urine samples and they are not suitable for continuous hydration monitoring. Pedram et al. developed a smart bottle technology that tracks the type and amount of different beverages taken [2]. Sabry et al. developed an on-device machine learning tool for predicting the time of the last water drinking event [3].

In this study, in addition to wearable sensors to estimate acceleration, heart rate, temperature, electrodermal activity (EDA), etc., we would like to integrate the environmental variables, such as weather, location, and the condition of the person's surroundings. This will help our system estimate the adjusted need for water intake and track the hydration accordingly. We also want to explore if dehydration can be detected from other signs such as certain movements, postures, or activities.

Consider an individual with a certain body weight, w kilograms, whose baseline environmental parameters (activity, location, weather, room temperature, etc.) are represented by a d-dimensional vector, $v \in \mathbb{R}^d$. Suppose, the recommended consumed water at time t of a day at the baseline environment is y_t liters, $y_t = f(v, w, t)$. The current environmental parameters are represented by the vector v'. Part of the vector v', such as outside temperature, humidity, etc. can be collected from online sources through a smartphone app. The rest, for example, activity, room temperature, etc. will be evaluated from the wearable sensor data with machine learning. Now, the adjusted recommended water consumption is calculated by $y'_t = f(v', w, t)$. Now, if the actual amount of water consumed until time t is x_t and $x_t < y'_t$, our system will recommend drinking $y'_{t+\Delta} - x_t$ liters of water over a time period Δ. The time period Δ is introduced to avoid drinking too much water at once if the hydration gap $y'_t - x_t$ is very large. For small hydration gaps, Δ can be 0. The HydraSense system is built upon two machine learning systems, one to construct the missing parameters of the environment vector v' and the other to estimate the current hydration level, x_t.

With a dataset that keeps track of the sensor data, environmental parameters, and the hydration level, we aim to develop a machine learning solution that will be able to predict if a person is well-hydrated or dehydrated at a particular time, provide an alert, and suggest an intervention depending on the severity of dehydration as shown in Fig. 1.

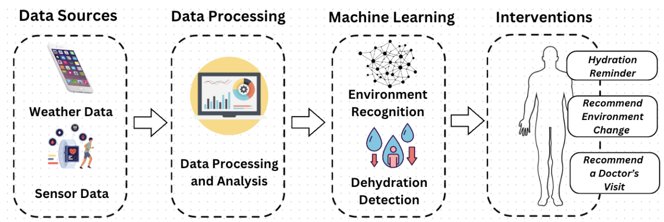

Fig. 1: The proposed HydraSense system uses weather data and wearable sensor data to predict activity, environment, and hydration level and detect dehydration.

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