A Novel Noninvasive Method for Skin Hydration Quantification: A Data-Driven Approach for Early Physiological Monitoring

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Dehydration is one of the leading causes of hospital admissions. Evaluations to measure hydration status in clinical settings utilize methods such as blood tests, urinalysis, and skin turgor. These methods are oftentimes invasive, inaccurate, timely, and can be altered by underlying medical conditions. This project investigates whether electrical impedance could be used as a noninvasive method to quantify hydration levels using a human skin model. A model was created using materials analogous to the composition of human skin to simulate varying hydration levels. An electrical impedance data acquisition system was then constructed, which incorporated electrical probes and a circuit to gather electrical signals. Over a period of two weeks, the mass of the skin model and electrical impedance values were collected. The results showed that as the skin model lost mass and dehydrated, the electrical impedance increased in a linear fashion for all given trials, with a r-squared value of .903. After 6 trials, a p-value of 7.34e-22 was found. A machine learning model was developed using the collected data. This model was trained to categorize hydration status as hydrated, moderately hydrated, and dehydrated, allowing users to receive a prediction of hydration state based on electrical impedance. These results could be applied towards patients with conditions such as sepsis, where continuous hydration monitoring could assist in early detection of their deterioration. Devices such as wearable technology could incorporate this to allow for real time data collection of hydration status.

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