

DETECTING POSTURAL INSTABILITY AMONG HEALTHY YOUNG ADULTS USING NANO SENSOR WAVELET TRANSFORMS AND NEURAL NETWORK ANALYSIS

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ABSTRACT

Falls are a significant public health concern among older adults, leading to morbidity, mortality, and financial costs. However, there is a paucity of clinical objective tools that can detect nuances in postural control leading to fall accidents. These subtle postural signatures remain unnoticed by caregivers, families, or clinicians who visually check for postural changes. In this study, we utilized a wearable IoT device and advanced deep neural networks to detect minute changes in postural movement that lead to falls. We collected data from 23 participants 15 males and 8 females with ages 24-30 years, average height of 160-183 cm and Body Mass Index (BMI) of 18.5-24.9. Wavelet decomposition using Daubechies mother wavelet and spectral analysis were performed to extract critical features as input to the Neural network. A Deep Neural Network is developed in Edge Impulse software with 3 hidden layers and 55 neurons. The best performance was found with the mother wavelet of db4 with an accuracy of 92.4% and F1-score of 92.8% We found IoT devices along with artificial intelligence can empower clinical judgements by noticing slight postural deviations that are not visible to the human eye. Our results show the promise that wearable IoT systems can accurately monitor postural deteriorations and determine fall risk, making it a promising tool for improving the safety and independence of older adults in home and community living environments.

Keywords: Nano 33 BLE Sense IoT chip, wavelet, Neural Network, Postural Instability Detection style, wearable system, fall risk.

INTRODUCTION

Falls are a significant public health issue for older people. Falls among adults who are 65 years and older caused over 36,000 deaths and 3 million emergency department visits in 2020. Between 2012 and 2021, the age-adjusted death rate from falls among older adults rose by 41%, from 55.3 to 78.0 deaths per 100,000 individuals. Addressing the growing incidence of fall-related deaths in older adults requires identifying those at risk through screenings and targeting interventions towards mitigating factors that affect balance and sensory functions. Traditionally, fall prevention and detection have depended on subjective physical evaluations and self-reported information, which might not capture minor changes in postural control and balance resulting from sensory decline in older adults [1][2][3][4]. There is a need for more sensitive tools capable of detecting these subtle postural adjustments linked to sensory impairment. Advancements in modern wearable technology have significantly expanded our capabilities to monitor human movement using Internet of Things (IoT) devices outfitted with sensors [5][6][7]. These devices can leverage sophisticated machine learning algorithms to sift through complex movement data and identify patterns or anomalies and have potential to predict events such as "*loss of balance*" among