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IMU Sensor-Based Gait Analysis System for Stroke Risk Identification in Older Adults

W.A.D.S. Malinge[1], K.D.S. Yashodana[1], D.M.C.M.B. Dissanayake[1], H.G.C. Nimnathara[1], J.W.A. Madushika[1], K.K.D.C.S. Weerarathne[1]*

[1] Department of Engineering Technology, Faculty of Technology, University of Ruhuna, Sri Lanka

**Corresponding author:* achini@etec.ruh.ac.lk

Stroke is a leading cause of deaths and long-term disability among the older adults worldwide. For each successive 10 years after age 55, the stroke rate more than doubles in both men and women. The walking pattern of a person reflects his neurological health status of the body. Patients with neurological diseases, such as stroke, show deviations in walking parameters from normal values. These walking parameters include step length, stride length, number of steps per minute, stance and swing duration, double support time and walking velocity. The availability of an early stroke identification tool can help reduce disability and mortality among older adults through timely clinical intervention and preventive care. Therefore, a wearable inertial measurement unit (IMU) sensor-based gait analysis system was developed to detect stroke-related gait abnormalities and support rehabilitation monitoring in older adults. The IMU sensor-integrated sock band was developed using elastic material and attached to the shank (the part of the leg below the knee and above the ankle) to measure angular velocity and acceleration in the sagittal plane during walking. These measurements were combined using a gravity-based complementary filter to detect heel strike and toe-off, which were then used to calculate gait parameters. A linear regression machine learning model was developed using Python and Scikit-learn to classify people as healthy or stroke patients based on gait parameters. This model used a publicly available dataset and aims to support automatic gait analysis and stroke risk identification. The system supports single-session gait screening and longitudinal monitoring, comparing sessions to baselines for classifying status and tracking stroke recovery. The system could assist doctors in monitoring rehabilitation outcomes and making informed healthcare decisions. The system has the potential to support clinical decision-making by assisting physicians in identifying patients with abnormal gait patterns who may require further clinical assessment.

Keywords: Gait analysis, Inertial measurements units, Stroke risk identification, Wearable sensors, Machine learning