

ABSTRACT

Abstract

Falls can occur unexpectedly and pose significant risks, including fractures, reduced mobility, and increased dependence. This study proposes a real-time fall detection system using an IMU sensor to monitor body movements, including acceleration, angular velocity, and orientation. Four machine learning models, Support Vector Machine (SVM), Random Forest (RF), Convolutional Neural Network (CNN), and Artificial Neural Network (ANN), were evaluated to determine the optimal model for fall detection. Data were collected through simulated fall and non-fall activities, including walking, standing, and different types of falls (forward, backward, and sideways), synchronized with IMU data at a sampling rate of 100Hz. The ANN model demonstrated the highest performance with 98% accuracy and a 0.1s latency, followed by CNN (97%, 0.3s), RF (97%, 0.3s), and SVM (90%, 0.5s). The system is designed to trigger an immediate protective response, such as airbag activation, upon detecting a fall. These results emphasize the potential of ANN-based algorithms for fast and reliable fall detection in wearable airbag systems.

Keywords: IMU sensor, fall detection, machine learning, ANN, airbag vest.