A Novel Approach for Feature Extraction to Efficiently Determine the Unique and Distinctive Characteristics of Human Activity

Suraj Deb Barma *
PhD Scholar, Department of Computer Science & Engineering, The ICFAI University Tripura, Kamalghat, Mohanpur, West Tripura, India

Dr. Abhijit Biswas
Associate Professor, Department of Computer Science & Engineering, The ICFAI University Tripura, Kamalghat, Mohanpur, West Tripura, India

Abstract

Human Activity Recognition (HAR) using either wearable or ambient sensors has become a key component in healthcare monitoring, rehabilitation, and smart environments. Ever since HAR was introduced, the extraction of discriminative features capable of capturing temporal and spatial characteristics representative of different human activities, while standing robust against user variation and sensor noise, has been one of the most challenging open issues. This paper addresses these issues with an innovative hybrid feature extraction approach, called Hybrid Multi-Domain Feature Extraction (HMDFE), which hinges upon time–frequency transformations, morphological analysis, and correlation-based descriptors to detect pattern and micro-movements within human activity signals. This letter transforms raw accelerometer and gyroscope signals using Continuous Wavelet Transform (CWT) and Short-Time Fourier Transform (STFT); extracts multi-scale statistical and morphological features; and encodes inter-axis correlations via Gramian Angular Fields (GAF). Experiments on benchmark datasets like UCI HAR, WISDM, and PAMAP2 show that the proposed approach outperforms existing classical handcrafted and deep learning-based feature extractors regarding classification accuracy and F1-score.

Keywords

Human Activity Recognition (HAR), Feature Extraction, Multi-domain Features, Wavelet Transform, Morphological Analysis, Machine Learning, Sensor Data.