

Title: Hybrid Human Activity Recognition Using WIFI CSI Data

Author: Francisco Francisco Ribeiro (up201809215@edu.fe.up.pt)

Date: November 15, 2024

Proposal Description

Project Idea

This project focuses on human activity recognition (HAR) using Wi-Fi Channel State Information (CSI) through a hybrid approach combining deep learning for feature extraction and conventional machine learning for classification. Convolutional Neural Networks (CNNs) will be employed to extract spatial features, capturing variations in the CSI data caused by human movements, while Long Short-Term Memory (LSTM) networks will analyze temporal dependencies, ensuring effective modeling of sequential activity patterns. The extracted features will then be classified using traditional machine learning algorithms such as Random Forest (RF), Support Vector Machines (SVM), or k-Nearest Neighbors (k-NN).

The system will be designed to classify a variety of activities, including walking, running, sitting, standing, lying down, and falling. These activities are particularly relevant for applications in smart homes and healthcare monitoring, where accurate recognition of daily and critical movements can enhance user safety and comfort. By focusing on a hybrid approach, this project aims to combine the robust feature extraction capabilities of CNNs and LSTMs with the computational efficiency of conventional machine learning classifiers, ensuring high accuracy and adaptability in diverse real-world environments.

Data Set

The dataset to be used for this project is the public dataset introduced by [1], which contains Wi-Fi Channel State Information (CSI) data collected using an Intel 5300 NIC. It includes six classes of human activities: lying down, falling, walking, running, sitting down, and standing up. The data was collected in an indoor office environment with a setup involving a Wi-Fi transmitter and receiver, capturing the effects of human movement on signal properties. Each activity was performed 20 times by 6 participants, resulting in a well-structured and labeled dataset suitable for human activity recognition.

Relevant Literature

The literature highlights CSI's potential for HAR, with [1] demonstrating its ability to capture motion effects, [2] CNNs and LSTMs for feature extraction, and [3] exploring hybrid approaches combining deep learning with traditional methods for improved accuracy.

Proposed Implementation

For the completion of the project it is expected that the following software components will need development:

- **CSI Data Preprocessing:** Tools to clean and structure raw CSI data.
- **Feature Extraction:** Implementation of CNN and LSTM models.
- **Classification:** Integration of traditional classifiers (e.g., SVM, RF).
- **Evaluation:** Modules for performance testing and accuracy analysis.

References

- [1] S. Yousefi, H. Narui, S. Dayal, S. Ermon, and S. Valaee, “A Survey on Behavior Recognition Using WiFi Channel State Information,” *IEEE Communications Magazine*, vol. 55, pp. 98–104, Oct. 2017.
- [2] E. Shalaby, N. ElShennawy, and A. Sarhan, “Utilizing deep learning models in CSI-based human activity recognition,” *Neural Computing and Applications*, vol. 34, pp. 5993–6010, Apr. 2022.
- [3] P. Fard Moshiri, R. Shahbazian, M. Nabati, and S. A. Ghorashi, “A CSI-Based Human Activity Recognition Using Deep Learning,” *Sensors*, vol. 21, p. 7225, Jan. 2021. Number: 21 Publisher: Multidisciplinary Digital Publishing Institute.