

# **A TIME-SERIES-FOCUSED NEURAL NETWORK FOR ACCURATE WIRELESS HUMAN GESTURE RECOGNITION**

Author's: R. Samuvel, K. Sujith, N. Vanjulavalli

## **Abstract**

Wireless Human Gesture Recognition (HGR) has emerged as a transformative technology in intelligent sensing, enabling contactless interaction between humans and digital systems. Conventional gesture recognition approaches rely on wearable sensors or vision-based systems, which suffer from privacy concerns, environmental dependency, and hardware limitations. Recent advancements in WiFi sensing and Channel State Information (CSI) analysis have opened new possibilities for device-free, privacy-preserving gesture recognition systems. This project presents a Time-Series Focused Neural Network framework for accurate WiFi-based Human Gesture Recognition. Unlike traditional 2D CNN-based approaches that treat CSI signals as images and often neglect temporal dependencies, the proposed system models CSI data as 3D video-like representations. A 3D Convolutional Neural Network (3D-CNN) is implemented to simultaneously capture spatial and temporal features from CSI amplitude data. Additionally, an Adaptive Normalization (AdaNorm) technique is integrated to enhance training stability and improve generalization performance. The system is evaluated on multi-environment gesture datasets containing up to 276 gesture classes and multi-user scenarios. Experimental results demonstrate superior recognition accuracy exceeding 99% in controlled environments and strong robustness in mixed and multi-user conditions. The proposed approach significantly outperforms conventional machine learning and 2D CNN-based baseline methods. This study demonstrates that modeling WiFi CSI signals as time-series video-like data combined with 3D convolution significantly enhances gesture classification performance. The system provides a scalable, privacy-preserving, and cost-effective solution for next-generation human-computer interaction systems.