

Fall Detection System Using Smartphone Sensors (Deep Learning + Real-Time Inference)

Objective

Develop a real-time fall detection system using only smartphone accelerometer that can distinguish between normal activities and actual falls with **zero false alarms**.

Methodology

- Data Collection**
 - Recorded 5 activities using Android phone at ~200Hz
 - Total ~370k samples across walking, running, standing, pocket, falls
- Preprocessing (`preprocess_data.py`)**
 - Sliding window: 400 samples (2 sec), 50% overlap
 - Total windows: 1,829
 - Stratified train-test split (80-20)
 - StandardScaler normalization (fit on train only)
- Model Training (`train_model.py`)**
 - 1D Convolutional Neural Network
 - Early Stopping + Reduce LR on Plateau
 - Best model restored automatically
- Real-Time Inference (`real_time_inference.py`)**
 - Live data streaming via PhyPhox app (WiFi)
 - Sliding window buffer using `deque`
 - Same scaler and model used
 - Console + potential live plot output

Results

- Overall Accuracy: **96.17%**
- Fall Detection Precision: **100.00%** (0 false alarms)
- Fall Detection Recall: 89.36%
- Standing Detection: 100% accurate

Conclusion

Successfully built a production-ready fall detection system with **zero false positive fall alerts** — critical for real-world deployment where false alarms destroy user trust.

The system is fully functional and runs live from any Android phone using free PhyPhox app.

Tools & Libraries

Python, TensorFlow, Keras, NumPy, Pandas, Scikit-learn, Matplotlib, PhyPhox

NISA HOORAIN